5

APRO 902
FINAL

LEVEL

(6) FORECASTING ARMY BUDGET

COMMITMENTS AND OBLIGATIONS.

(9) Final rept.,

(10)

Richard C. / Brannon

Uldis R. / Poskus

(11) JAN 80   (12) 120

(14) APRO-902

APRO

ARMY PROCUREMENT RESEARCH OFFICE

U.S. ARMY LOGISTICS MANAGEMENT CENTER
FORT LEE, VIRGINIA 23801

406825

80   6 3   022

ADA085110

DEPARTMENT OF THE ARMY
UNITED STATES ARMY LOGISTICS MANAGEMENT CENTER
FORT LEE. VIRGINIA 23801

DRXMC-PRO   20 May 1980

SUBJECT: Army Procurement Research Office Report APRO 902, Fore-
casting *Army Budget Commitments and Obligations*

SEE DISTRIBUTION

Inclosed is a copy of subject report for your use. Addressing the
customer program only, this study finds the statistical relationship
between orders and obligations too weak to permit precise forecasting.
Since forecasting obligations continues to be an important topic,
both procurement offices and cost analysis offices may find the
methodology and the data useful in their future work.

FOR THE COMMANDANT:

1 Incl   PAUL F. ARVIS, Ph.D.
as   Director, US Army
                                     Procurement Research Office

DISTRIBUTION LIST

FOR APRO FINAL REPORTS

Chairman, Defense Acquisition Research Council
ASA(RD&A), ATTN: Deputy for Acquisition
Office of Federal Procurement Policy
Defense Systems Mgt College, ATTN: Dir, Acquisition Research
Commanders
   USA Mat Dev & Readiness Command, ATTN: DRCPP-SP
   USA Armament R&D Command, ATTN: DRDAR-PRC
   USA Armament R&D Command, ATTN: DRDAR-CP
   USA Armament Materiel Readiness Command, ATTN: DRSAR-PP
   USA Armament Materiel Readiness Command, ATTN: DRSAR-CP
   USA Aviation R&D Command, ATTN: DRDAV-PCP
   USA Aviation R&D Command, ATTN: DRDAV-C
   USA Communications & Electronics Materiel Readiness Command,
     ATTN: DRSEL-PP-P-PP
   USA Communications & Electronics Materiel Readiness Command,
     ATTN: DRSEL-CP
   USA Communications R&D Command, ATTN: DRDCO-PC
   USA Communications R&D Command, ATTN: DRDCO-CP
   USA Electronics R&D Command, ATTN: DRDEL-AQ
   USA Electronics R&D Command, ATTN: DRDEL-CP
   USA Missile Command, ATTN: DRDMI-I
   USA Missile Command, ATTN: DRDMI-F
   USA Tank-Automotive R&D Command, ATTN: DRCPM-FV-L
   USA Tank-Automotive R&D Command, ATTN: DRDTA-K
   USA Tank-Automotive Materiel Readiness Command, ATTN: DRSTA-I
   USA Tank-Automotive Materiel Readiness Command, ATTN: DRSTA-E
   USA Test & Evaluation Command, ATTN: DRSTE-PR
   USA Test & Evaluation Command, ATTN: DRSTE-CP
   USA Troop Support & Aviation Materiel Readiness Command, ATTN: DRSTS-PB
   USA Troop Support & Aviation Materiel Readiness Command, ATTN: DRSTS-C
   Air Force Business Research Management Center, ATTN: RDCB
   Air Force Contract Management Division, ATTN: AFMCD-RR
   US Naval Material Command, ATTN: MAT 0233
Office of the Project Manager for Training Devices, ATTN: DRCPM-TND-PP
Defense Documentation Center, ATTN: DDC-TCA, Cameron Station
US Army Library, The Pentagon
Federal Acquisition Institute Library, Washington, DC

FORECASTING ARMY BUDGET COMMITMENTS AND OBLIGATIONS

by

Richard C. Brannon
Uldis R. Poskus

January 1980

Information and data contained in this document are based on input
available at the time of preparation. Because the results may be
subject to change, this document should not be construed to represent
the official position of the US Army Materiel Development and Readiness
Command unless so stated.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

A. BACKGROUND. As part of the Planning, Programming and Budgeting process
the Army must forecast the level of activity for its customer program.
Historically, the amount actually purchased has often been less than the
amount forecasted (in FY 79 this was not a problem). This difference causes
several problems, as discussed in the report. Previous studies have tried
to provide improved forecasts, but used inappropriate techniques or were
based on insufficient data bases.

B. STUDY OBJECTIVES. This study seeks to forecast the amount and timing
of procurement obligations for the Army's Customer program (Foreign Military
Sales, Military Assistance Program, and Other), given customer orders or
other driving variables. The study seeks also to forecast these driving
variables. The study seeks to develop an aggregated statistical forecast,
rather than to provide improved procedures for estimating individual actions.
Specific objectives are (1) develop and apply improved procedures for
forecasting customer obligations, (2) determine the statistical relationship
between orders and obligations, taking into account the timing and delay
between orders and obligations, (3) provide confidence intervals as well as
point estimates for the forecasts, and (4) determine the applicability of
the procedures to forecasting the Direct Army program.

C. STUDY APPROACH. The authors examined budget execution policies and
procedures for the customer program and reviewed the literature on economic
forecasting. One hundred twenty-eight pairs of data points were collected,
reflecting historical orders and obligations for each of the five procure-
ment appropriations. Several statistical methods were evaluated, including
polynomial regression, multiple regression, and exponential smoothing. Time
series methods (both univariate and transfer function analysis) were used
to quantify the relationship between orders and obligations. Ratios and
factors were developed to provide an alternate method of forecasting, when
an estimate of year end orders is available. An organizational perspective
provided further insights into the process.

D. FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS. The timing of orders does
not drive the timing of obligations, and so orders cannot be used to pro-
duce time-phased statistical forecasts. However, the amount of year-end
orders does influence the amount of year-end obligations, and the obligation
curves are similar from year to year. These facts allow forecasts to be
made, and tables are provided for use in making point estimates and con-
fidence intervals. Use of these methods for the direct Army program is not
recommended. Organizational considerations seem to be influencing, and
possibly dominating the process, and further work should address the methods
by which the obligation goal is set. Other findings, conclusions and
recommendations are provided in the study.

CHAPTER I

INTRODUCTION

A. BACKGROUND.

As part of the Planning, Programming, and Budgeting process the Army must estimate the amounts and timing of funds required. Due to the budget schedule the estimated annual requirements must be submitted to Congress 18 months before the beginning of the fiscal year. It has been very difficult for the Army (and other services) to develop accurate forecasts this far ahead. While the original forecasts can be updated as more data become available, the difference between the original forecasts and the amounts actually purchased has caused several problems.

Some outside the Army have asked whether the "shortfall" reflects an inability of the Army to perform its programs. GAO (1978) found that this was not the case. Some in Congress have asked whether the unused funds for the items not bought could be used elsewhere, perhaps to reduce future appropriations. The Army (and other services) usually respond that the items are still required and will be purchased in the next year (procurement appropriations are available for new obligation for three years).

The two examples just given illustrate criticism from outside the Army when obligations fall below the forecast. But the President and others have

also objected when obligations appear unusually high, especially in the
last month of the fiscal year. Forecasting errors, and the resulting loss
of credibility, have caused much criticism in recent years.

Inaccurate forecasts can also cause problems between different levels
within the Army. In a complex program many activities have to be scheduled
to occur at specific times. When the schedule for one item slips, many
other items may be affected. The uncertainty about schedule makes necessary
a time-consuming dialogue between different levels about the amount and
timing of funds needed at the lower level. And much effort goes into the
preparation of reports explaining why the amount actually obligated is
different from the amount planned. Each level is under pressure to justify
its plan, but no level has a precise forecast.

Unrealistic forecasts could result in less efficient means of pro-
curement personnel accomplishing their functions. If the amount of funds
obligated by an individual contracting office falls behind the plan,
that office may feel pressured to achieve the plan by emphasizing the
placement of large dollar-amount contracts while deferring placement of
many other equally important but small contracts. In some cases a
contract with a tentative price (such as a letter contract) may be
used instead of another more desirable, but time consuming form. In
other cases procurement planning, Should Cost studies, and audits
may be deferred or cancelled in order to place contracts

according to a forecast made long before. In each of the examples above, the contract may be for a valid requirement, but the timing or the method used was driven by an overoptimistic forecast.

The Army has used two main approaches to reduce the problems described above. The first approach is to make the budget execution process more responsive and flexible through the use of new management information systems, word processing procedures, and the realignment of organizational functions. This approach has been partly successful, and improvements continue. The second approach, used by this study, is to try to improve the original forecasts and thereby begin the fiscal year with a more realistic plan.

The present forecasts are developed by the MSC's using a "bottoms-up" approach. Knowledgeable persons at each MSC estimate the type, quantity, cost, and schedule of items required for the Army's own use (the direct Army program) and for those who buy Army-managed items through the Army (the customer program).[1] These individual forecasts are aggregated and become the official forecast. In some cases DARCOM, after coordination with the MSC, asks the MSC to adjust these forecasts. The study sponsor must manage both the direct Army and the customer programs, but improved techniques are more critically needed for the customer program because it is more difficult to forecast. Therefore, this study analyzed customer forecasting.

---

[1]Chapter II clarifies certain terms and concepts unique to the budget execution process.

There are many events that can cause the amounts and timing to fall behind the plan. For example, sometimes it is desirable to wait for additional customer orders in order to achieve a quantity discount from the contractor. Legal problems can delay the contracting process. Orders from foreign countries can be cancelled, as happened recently in Iran. On the other hand, very few events can happen to accelerate the program. The Army cannot easily pressure the State Department or contractors to respond more quickly. It is difficult to replace customers who have cancelled orders. As a result, the amounts actually obligated are usually much less than the amounts forecasted.

There have been several recent attempts to develop improved forecasting methods. Since the amounts and timing usually fall behind the plan, it would seem possible to develop adjustment factors, based on historical data, which could be used to correct the traditional forecasts. Perry (1979) used this approach with little success. Brannon (1977) used a multiple regression approach to forecast the cumulative amount obligated at the end of the fiscal year with little success. Chapter III discusses several methods that have been or might be tried.

It appears that no Army organization has been able to prepare a precise forecast for its procurement appropriations. The lack of an accurate forecast has caused problems between the Army and others. It has also caused problems within the Army. While many studies have tried

4

to develop better forecasting methods, they have used either inadequate data bases, or have used inappropriate analytical techniques. The Army still needs a good long range forecast of obligations.

B. STUDY OBJECTIVES.

This study seeks to develop improved procedures for forecasting the amount and timing of customer procurement obligations, given some variables such as customer requests for pricing data, customer orders, commitments, or time. The study seeks also to forecast these variables. These two forecasts are to be combined. For example, if one can forecast orders n months ahead, and if orders can be related to obligations with an average delay of m months, then one can forecast obligations (n+m) months ahead.

The study seeks to provide an independent statistical forecast for use by Headquarters, DARCOM, rather than to provide improved procedures for use by MSC's in estimating individual actions. Such a parametric forecast should complement and not replace the detailed planning that will still be required for management of each case. Specific objectives of this study are to:

1. Describe and analyze the customer obligation process.

2. Determine the relationship between customer obligations and customer orders, or other driving variables, explicitly taking into account the timing and delays between the variables.

5

3. Develop and apply improved procedures for forecasting customer obligations, to include confidence intervals as well as point estimates.

4. Determine the applicability of the developed procedures to forecasting the direct Army program.

5. Identify any problems found and recommend improvements to the process.

C. SCOPE.

This study addresses the five customer procurement appropriations (Procurement of Aircraft, Procurement of Missiles, Procurement of Weapons and Tracked Combat Vehicles, Procurement of Ammunition, and Procurement of Other). Appropriations such as Research, Development, Test and Evaluation, Military Construction, and Operations and Maintenance were not addressed. For each of the five appropriations data were collected using the following breakout: Foreign Military Sales (FMS), Military Assistance Program (MAP), Other, and Total. These terms are explained in Chapter II.

D. STUDY APPROACH.

The budget execution process was examined, and the process for the customer program was found to be different from the direct Army program in several ways, including the identification of requirements, the control of funds, and the recording of data. These findings are summarized in Chapter II.

A literature review and interviews showed that MSC's continue to refine their bottoms-up approach described above, and the authors do not duplicate the current work in this area. Some studies have attempted to compare the

traditional forecasts of obligations with the amounts ultimately obligated. Any percentages developed from this approach, however, would have to be applied to an intrinsically soft figure (the traditional forecast), and the result would necessarily be soft. This approach was rejected.

Other studies have compared historical obligation goals to the amounts later obligated. The authors felt that no accurate forecast could be based on a study of such goals. In fact, some studies seemed to show a confusion between forecasts and goals. This matter is clarified in Chapter III.

It appears that the obligation process has always been treated as a statistical or as a management information problem. No study was found which viewed the process as a complex system with many levels and multiple (perhaps conflicting) goals. A very brief description of the budget execution process from an organizational perspective was developed.

After completing the literature review and interviews, a list of candidate forecasting techniques was compiled, including polynomial regression, multiple regression, exponential smoothing and others. All are evaluated in Chapter III. Box-Jenkins time series analysis (both univariate and transfer functions) was selected as the most suitable in the present context. Time series analysis is a forecasting (as opposed to curve fitting) technique and explicitly addresses the delays within the

system and the lack of statistical independence between consecutive months. Another approach, called ratio analysis, was developed for this study to take advantage of the unusual configuration of the data set.

Several variables were candidates for analysis. The main variable of interest is, of course, customer obligations. Perhaps the earliest precursor of an obligation is the customer's initial request for price data. However, some customers do not request this information, and some who do request it do not place orders. If potential customers were queried about their intentions, some useful information might result, but the use of initial "feelers" did not seem promising. Commitments occur much closer in time to obligations. They are probably too close for use in long range forecasting and are several steps removed from the logical driver of obligations, which is firm (or "accepted") customer orders. Monthly data for customer orders and customer obligations were collected and are recorded in Appendices A through E.

The data were analyzed and findings, conclusions, and recommendations were drawn. But before describing the analysis it is necessary to define some budget terminology and describe the process by which customer orders finally result in contract awards resulting in the obligation of funds.

CHAPTER II

THE OBLIGATION PROCESS FOR CUSTOMER PROCUREMENT FUNDS

A. INTRODUCTION.

The sale of military hardware in the United States is controlled by
Congress. Congress will not permit foreign countries to buy military
hardware from American contractors unless these purchases are supervised
by the Department of Defense. In this way the US Government retains con-
trol over the level of activity and also enjoys price advantages due to
the combined (US and foreign) quantities. Congress exercises its control
for the customer program by establishing an authorization called the
Funded Reimbursable Authority (FRA) which is, in effect, a ceiling up to
which the Army may award contracts for customers. In some cases Congress
and the Department of State retain additional control in the form of a
final veto power, and their written approvals must be obtained before the
Army can award specific contracts.

This chapter defines some of the budgeting terms used, outlines the
procedures by which the Army, as agent for the US Government, supervises

the purchase of military hardware by foreign countries, describes the special labeling required to identify funds, and describes how the data were extracted and relabeled for the present analysis. Since this study is concerned mostly with obligations, it will not describe the various trust funds used for holding customer money, except to say that customer funds are not mixed with direct Army funds; and it will not describe how payment is made to the contractor (expenditures). The customer process is much more complex than can be described here. For example, some items are provided from the Army's current inventory and not from a production contract. Depending on whether or not the item is obsolete (to the US), the Army may or may not rebuy the item. It is, of course, only a contract that constitutes an obligation in the budgetary sense. More detail is available in the Military Assistance and Sales Manual (MASM).

B. THE CUSTOMER PROCESS.

The acquisition process for the customer program includes eight main steps, as follows:

1. The customer approaches the Army (specifically, the US Army Security Assistance Center, USASAC) asking for information on price and availability or for a specific offer.

2. The request is sent to the appropriate case manager at the Major Subordinate Command (MSC) responsible for the item. The case manager

prepares a Letter of Offer (Form 1513) describing the name of the item, quantities, schedules and a tentative price. The Letter of Offer is sent to the customer for signature.

3. The customer signs the document, now called a Letter of Offer and Acceptance (LOA), and returns it through USASAC to the case manager at the MSC. The returned LOA, when it is recorded by the MSC, constitutes an "order."

4. The case manager obtains any necessary approvals from Congress or the Department of State.

5. The Army and the American contractor decide on a price for the quantity required in accordance with procedures established in the Defense Acquisition Regulation (DAR).

6. Both the contractor and the Army (Contracting Officer) sign the necessary legal instrument. This can be a new contract, a modification of an existing contract, or the exercise of an option clause on an existing contract. The signed agreement is a legal obligation, and when it is recorded by the MSC, it constitutes an "obligation" in the budgetary sense.

7. The hardware is delivered to the customer.

8. Payment is made to the contractor.

The Army uses five categories to classify the orders and obligations above. These categories are named: Procurement of Aircraft (also known

as 2031^2 for the customer program), Procurement of Missiles (2032), Procurement of Weapons and Tracked Combat Vehicles (2033), Procurement of Ammunition (2034) and Procurement of Other (2035). Although Army appropriations are not used for the customer program, these categories are traditionally called procurement appropriations. They correspond to five similarly-named procurement appropriations used for direct Army requirements.

Each of these appropriations has a life of three years, during which new obligations can be made against the appropriation. Each fiscal year Congress establishes a new set of five appropriations, so that there is always some overlapping. For example, at any point in time there are three active appropriations called, "procurement of aircraft." Funds cannot easily be transferred or reprogrammed among the five categories or among the three active years of a single category. Depending on the item the approval level for such a reprogramming can be the Office of the Secretary of Defense or even Congress.

C. DATA FOR ORDERS AND OBLIGATIONS.

The existence of so many (15) active accounts makes necessary a special data labeling to identify transactions. Comptroller offices traditionally describe the data using an expression of the form "7/9A," where the seven and nine refer to the first and last active years (FY 1977 and FY 1979, respectively, and the letter (A, B, or C) designates which of the three

---

^{2}The appropriation numbers are those used in the "307-21" report described in the next section.

12

years. For example, September, 7/9A refers to the month September of 1977, and to the FY 1977 appropriation. September, 7/9B refers to the month September of 1978, and to the FY 1977 appropriation, which is still active. For purposes of the present analysis, the data were relabeled more simply, by using the fiscal year (the year first available), and the number of months from the beginning of the appropriation (one through thirty-six). The two examples above become FY 77, month 12 and FY 77, month 24, respectively. This scheme facilitates analysis, because all data relating to month 12, for example, can be compared directly.

Historical data for orders and obligations were extracted from the report "Status of Procurement Appropriation Customer Financial Plan, Schedule 307-21" prepared by the Army Finance and Accounting Center. For each of the five customer appropriations the data are further categorized by: Foreign Military Sales (FMS, which covers sales to other nations which are providing their own funds), Military Assistance Program (MAP), which covers acquisitions for nations which are paying with grants provided by Congress), and Other (which is used primarily when the Army purchases items for other US agencies, for example, ammunition for the US Air Force). These data are given in Appendices A through E.

CHAPTER III

STATISTICAL FORECASTING

A. INTRODUCTION.

This chapter begins by clarifying the difference between a forecast and a goal, and by describing some of the adverse consequences to an organization if its operations do not reflect this difference. Since previous studies show confusion between curve fitting and forecasting, several traditional methods are compared, contrasted and evaluated. Box-Jenkins time series analysis is described briefly and then applied to Foreign Military Sales orders and obligations. Finally, ratio analysis, developed especially for this study, is described and applied to FMS, MAP, Other, and Total customer obligations. This method requires an independent estimate of year end orders, but seems to give reasonably accurate forecasts for months one through thirty-six.

B. FORECASTING AND GOAL DETERMINATION.

It is essential to distinguish between a forecast and a goal in order to understand the obligation process. For the purposes of this study a goal is a numerical target expressing what a specific organizational unit should achieve. Usually goals are negotiated between different levels and they reflect management decisions about what the future value of a variable (like obligations) should be. A forecast, on the other hand, is an objective

estimate of what the future value of a variable <u>will</u> be, if certain stated assumptions hold during the forecast period. For example, we forecast tomorrow's outside temperature, but our goal for tomorrow's inside temperature (achieved by setting a thermostat) is sixty-five degrees. Note that setting a thermostat outside in the winter will only result in the continuous operation of the furnace. It is impossible to achieve a goal for outside temperature, and it is unnecessary to forecast the inside temperature.

The Army uses the aggregated forecasts described above as its goal. Although each program estimate may reflect the best judgment available as to the amounts and timing of funds, there are more events which can slow down the process (cancellations, protests, strikes, etc.) than can speed it up. Thus the goal setting procedures may be causing the Army to start the year with an unrealistically high goal.

Another problem with these goals might be that they tend to perpetuate suboptimal procedures. Some offices may have achieved their goals by the excessive use of overtime (which is sometimes, but not always, desirable), by emphasizing the placement of large dollar-amount contracts (while smaller, equally important requirements are deferred), by use of letter contracts (usually judged less desirable than other types) or by deferring and cancelling important work such as planning and review. Historical data from such an office would lead to the conclusion that the same achievement is possible again next year. If this forecast were used as a goal, then the above procedures become necessary next year (and every year) in

15

order to achieve this inappropriately high goal. The present study did not collect data to support or to refute the occurrence of the practices above, but they were mentioned by several respondents, and are consistent with the data which show a large increase in obligations during month 12.

Figure 1 shows the relationship between forecasts and goals for the obligation of procurement funds. Using historical data for orders and obligations, and considering the projected workload and available resources to process it, the MSC's develop a forecast of obligations. After negotiation between the MSC and DARCOM an agreement is reached on an organizational goal. The MSC determines how to implement this goal, and it periodically reports its achievement. These reports are used later to update the historical data base.

Figure 1 illustrates two points about forecasting and goal determination. If new circumstances arise during the year, the original goal is still the target. Therefore, in order to achieve the goal under the new circumstances, the MSC's will probably have to change the method of implementation, for example, by scheduling overtime. Thus, the assumptions (about resources required) leading to the original forecast are invalidated later. The achievement at the end of the year may not relate directly either to the original forecast or to the goal. Secondly, note that the MSC's original forecast is used as the starting point in a negotiation process. This use may affect the objectivity of the forecast. The present approach for goal setting provides no direct link (such as a regression equation) between the

16

FIGURE 1

RELATIONSHIP BETWEEN FORECASTS AND GOALS

HQ DA

DARCOM

DATA

MSC

17
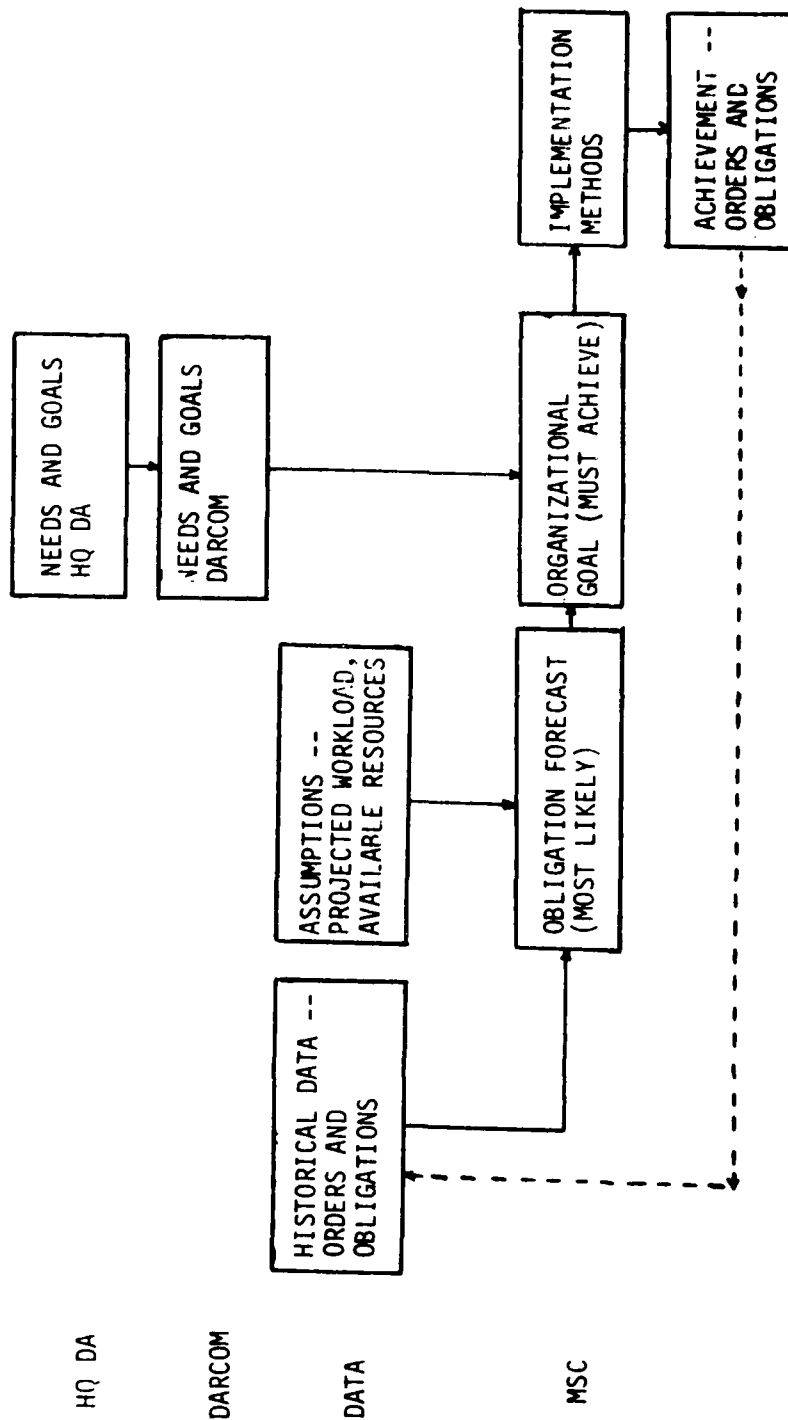
ultimate value of obligations and the resources and conditions required to achieve these obligations. Since more things can slow the process than can speed it up, the MSC's often find themselves in a crisis at the end of the fiscal year, trying to achieve the original goal.

Although this study uses historical data for orders and obligations, these data may partly reflect past efforts to achieve the goals negotiated between different Army levels (HQ DA, DARCOM, and the MSC's), rather than reflecting a purely statistical process in which orders flow through the system with constant speed, finally becoming obligations. Any forecasts based on historical Army data may reflect the influence of goals on the obligation process. However, the Army will probably continue to manage by goals, so any inferences from the data should continue to apply.

C. TRADITIONAL FORECASTING METHODS.

Previous studies have shown confusion between curve fitting and forecasting. It is true that a plot of cumulative obligations against months looks as if it could be fitted by some kind of curve. Even a straight line may give a high index of determination[3] and small estimation errors (actual data less fitted value) when fitted to historical data. However, these fits are not as valuable as they seem to two reasons. First, any cumulative data will correlate highly with months if the average increment

---

[3] The index of determination (R^2) measures the portion of the total variation about the mean which is explained by the curve or line.

18

is positive. Secondly, the shape and scale of next year's curve will
probably be different from the curve so carefully fitted to last year's
data. Every candidate forecasting procedure should be evaluated on the
accuracy with which it estimates future values, not historical values.

Several statistical methods have been used in recent attempts to fore-
cast obligations. If the variable t represents time in months from the
beginning of the fiscal year, then polynomial regression seeks to estimate
obligations (y) by using powers of t. Thus, $y = a + b(t)$ is a straight
line, $y = a + b(t) + c(t^2)$ provides for curvature, and inclusion of higher
power terms allows an increasing variety of shapes. Although historical
data for any single year can be fitted closely, both the shape of the
curve and the end-of-year amount vary widely from year to year. Polynomial
regression has not succeeded in previous Army forecasting studies and was
not explored further.

Multiple regression seeks to estimate obligations (y) by using in one
equation several obligation-driving variables, such as orders (x), time
(t) and any other variables having a significant influence. Multiple
regression is basically curve fitting in a higher dimensional space, and the
remarks above comparing curve fitting and forecasting apply. There are two
other objections to the use of multiple regression for forecasting obliga-
tions. First, the sequences of orders and obligations may show seasonal
patterns or statistical relationships between nearby values that can be
used in forecasting, but which multiple regression ignores. Second,
multiple regression can address the delay between orders and obligations

19

in only one way -- the use of lagged variables. There are more efficient
ways to model these delays.

Autoregressive models explicitly address the lack of independence
between consecutive months. Denoting obligations at time t by y_t,
autoregressive models use an equation of the form:

$$y_t = a + b_1 y_{t-1} + b_2 y_{t-2} + b_3 y_{t-3} + \cdots b_{12} y_{t-12}$$

Any dependence between values one, two or more months apart can be estimated, and
the necessary adjustments can be made to the forecast equation. Seasonal
patterns (a special type of dependence between values one budget cycle
apart) can also be handled with autoregressive models. Autoregressive
models actually are a special case of the Box-Jenkins time series approach,
which will be discussed more fully in the next section.

Exponential smoothing models (sometimes known as exponentially weighted
moving average models) seek to estimate obligations by using an equation of
the form:

$$y_t = (1-b)(y_{t-1} + b y_{t-2} + b^2 y_{t-3} + b^3 y_{t-4} + \cdots),$$

where b is called the smoothing constant. Exponential smoothing has given
good estimates in certain applications, such as in forecasting demand for
spare parts. Box and Jenkins (1976) show, however, that exponential
smoothing gives the optimal forecast for only one special situation; namely,
what they call the first order integrated moving average process. Thus,
the advantages of exponential smoothing will be obtained automatically
using the more general Box-Jenkins time series approach described next.

D. BOX-JENKINS TIME SERIES ANALYSIS.

1. Description.

This section briefly describes time series analysis and its application to forecasting customer obligations. The subject is much more complex than can be described here, and those interested in further detail should consult Box and Jenkins (1976) or for a more elementary presentation, Nelson (1973). Time series analysis in the present context seeks to estimate future values of obligations by using historical values of obligations (univariate time series analysis), or by using historical values of obligations together with historical values of orders (transfer function analysis). More independent variables can be handled by using multiple time series analysis, but the present study considered customer orders as the main driving variable. The somewhat complex statistical parts of this section are provided for completeness. Understanding the statistical parts is not essential to follow the results as they relate to forecasting obligations.

2. Univariate Analysis of Time Series.

Univariate time series analysis models a process such as monthly obligations by expressing the value at time t as a function of (a) previous values of the process, (b) previous forecasting errors and (c) a current forecasting error. A model using only previous values is called an auto-regressive process as discussed in the previous section, and a model using only previous forecasting errors is called a moving average process. In some cases (for example, when working with cumulative data) the analysis is made on the incremental differences from one month to the next. To recover

21

the original series the increments are summed. Instead of calling the original series "summed" however, the customary word is "integrated," borrowing from the theory of differential equations which are the continuous analogues of time series. The forecast errors are really unexplained deviations from the forecast and can be interpreted as "shocks" to the system. Their effects, whether immediate or delayed, can be represented in the moving average part of the model. An integrated model with one moving average term is the same as an exponential smoothing model. The term ARIMA refers to a model which potentially includes autoregressive (AR), integrated (I), and moving average (MA) terms. The point of modeling the present value in terms of previous values and forecast errors is to quantify the relationship, including any dependence between observations one, two, up to about 40 periods apart. If the relationship between present and past is stable (this can be tested in a long time series), the same relationship should hold between the future and the present. This allows forecasting.

The identification of which terms should be in the model is based on a study of the relationships between values k periods apart for each lag k from one to 40. The strength of the relationship is measured by the auto-correlation function (ACF) and the partial autocorrelation function (PACF). The ACF and the PACF are analogous to correlation and partial correlation in multiple regression. The ACF at lag five, for example, reflects the correlation between y_t and y_{t-5}, where t ranges over all observations

22

(except the first five, for which y_{t-5} is missing). The PACF at lag
five reflects the correlation between y_t and y_{t-5} that is <u>not</u> explainable
by the correlation at lags one through four. Thus, the PACF at lag five
helps determine whether to have a fifth order term or to stop at four
terms.

The identification process is diagrammed in Figure 2. If the ACF
declines very slowly, a new series is calculated using the consecutive
differences of the original series. Cumulative data always requires this
step, called "differencing." The new series may require differencing
again. The number of times the differencing step is performed is denoted
usually by the letter d, and if d is one or more the model is called
"integrated."

FIGURE 2

<u>IDENTIFICATION PROCESS</u>
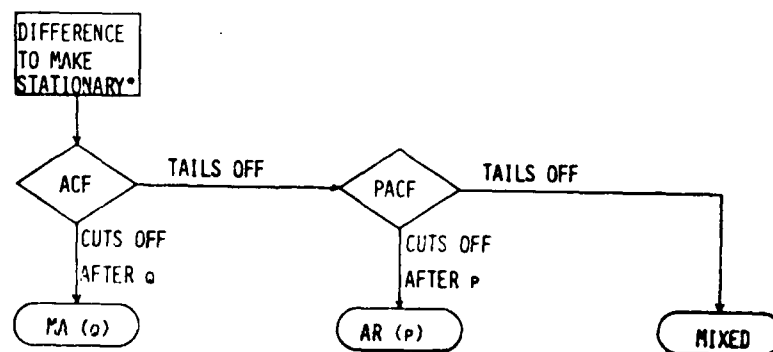
* INDICATIONS THAT DIFFERENCING IS REQUIRED --
  A) ACF TAILS OFF VERY SLOWLY
  B) SERIES SHOWS NO AFFINITY FOR A MEAN VALUE

After differencing d times the ACF is examined. If the ACF abruptly becomes statistically not significant after lag q, the model is tentatively identified as having q moving average terms, and no autoregressive terms. If instead, the ACF declines slowly, the PACF is examined. If the PACF cuts off after lag p the model is tentatively identified as having p autoregressive terms, and no moving average terms. If instead the PACF tails off (and the ACF tails off), the model probably has both moving average and autoregressive terms. In this case one can compare the ACF and PACF patterns to those of models having known forms. A model with p autoregressive terms, d stages of differencing and q moving average terms is called an ARIMA (p, d, q) model.

For this time series analysis FMS data were extracted for fiscal year 1976 (months 15 through 36), fiscal year 1977 (months 1 through 36), and fiscal year 1978 (months 1 through 21). FMS data were analyzed alone because they should be more homogeneous than the total (FMS plus MAP plus Other), and because FMS is the largest component. Data prior to month 15 of FY 1976 appeared to be very unusual, and data prior to month eight were missing, so analysis started with month 15 of FY 1976. Data after month 21 of FY 1978 were not yet available, so the data terminated at month 21 of FY 1978. The data from FY 1979 could not be joined at the end, because there is no way to handle the missing values

from months 22 through 36 of FY 1978, which will not be available until October 1980. The consecutive differences were taken to give obligations per month, instead of cumulative obligations. Five time series resulted (one for each appropriation) each having 79 data points. These are considered adequate sample sizes, since the traditional minimum sample size required for time series analysis is 50 observations.

Frequency plots were made of monthly obligations to determine whether or not they are normally distributed about a mean value. Obligations were found to be heavily skewed to the right, meaning that there are many months in which a small amount is obligated (sometimes a net value is negative, reflecting deobligations) and there are a few months in which a very large amount is obligated (often months in addition to month 12, which is always large). Logarithmic and square root transformations were made following Box and Cox (1964), with the square root transformation making the data much more normally distributed. Orders also show a right-skewed distribution.

The results of the univariate time series analysis are as follows. First, the ACF's show that a knowledge of recent historical obligations does not contribute significantly more to a forecast than knowledge of the monthly average value of the series. Second, while taking square roots makes the transformed obligation series more nearly normal, it does not improve the ability to forecast. One series, procurement of missiles (2032)

25

showed a significant autocorrelation function, but the biggest autocorrelation was only 0.40 (at lag four), and this is too low for useful forecasting. If FMS obligations cannot be forecasted from their own history (other than using an average value), it is worthwhile to determine whether knowledge of another related series, such as customer orders, can help. This idea is explored in the next section.

3. Transfer Function Analysis.

Time series analysis with transfer functions seeks to represent the value of the dependent variable (in this case FMS obligations) in terms of the previous history of that variable and the previous history of another, independent variable (FMS orders). The analysis is illustrated in Figure 3 which shows two water tanks connected by a long pipe.

FIGURE 3

OBLIGATION PROCESS

NET ORDERS = ORDERS - CANCELLATIONS   NET OBLIGATIONS =
                                                                                        OBLIGATIONS - DEOBLIGATIONS
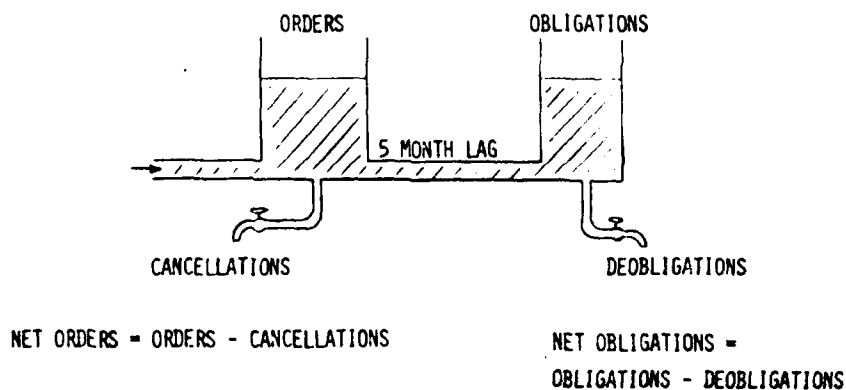
FMS orders arrive at the left; however, some orders are cancelled, leaving net orders which build up in the tank at the left. A long pipe connects the two tanks and after a period of time (up to five months if the Army has to wait for approvals from the Department of State, or accumulate

26

more FMS orders) the orders become obligations, represented by the tank at the right. Not every order becomes an obligation, so the obligation tank is shown as smaller. It is possible to reduce the size of a contract or terminate it, so the figure provides for deobligations. Obligations, less deobligations leave net obligations. Figure 3 reflects several aspects of the obligation process, including the delay or dead time before the input (orders) has any effect on the output (obligations). The spreading of one month's input to several output periods and the inertia in the output are also reflected in this model. A complete discussion of transfer function models is in Box and Jenkins (1976), and an introductory discussion is given in Helmer and Johansson (1977). A very brief discussion is provided here.

The continuous model shown in Figure 3 can be represented mathematically as a differential equation. The analogous discrete model underlying our data can be represented mathematically as a difference equation. The general form for such an equation is:

$$Y_t - d_1 Y_{t-1} - \cdots - d_r Y_{t-r} = w_0 X_{t-b} - w_1 X_{t-b-1} - \cdots - w_s X_{t-b-s}$$

where

Y_t = FMS obligations during month t.

X_t = FMS orders during month t.

d_i = Output lag coefficients, to be estimated from the data,

w_j = Input lag coefficients, to be estimated from the data,

b = Number of months of delay before any effect of an order can be seen in the obligation series.

The above equation relating Y and its history to X and its history is called a "transfer function" model, because it can be used to express the way variations in the input series are transferred into variations in the

27

output series. The delay between X and Y is reflected by the subscript b which shifts the comparison backwards in time. The w's reflect the more immediate effects of X on Y, and reach back s periods. The d's reflect any inertia, or gradual decay of the effect, and reach back r periods.

In univariabe time series analysis, the model was identified by using the autocorrelation function. In transfer function analysis the model is identified by using the cross correlation function (CCF) which, for each lag k, measures the relationship between obligations during month t and orders during month (t-k). Based on patterns observed in the CCF a tentative model is defined (b, r, and s are selected), coefficients are estimated (the d's and the w's in the equation), and the results are analyzed for possible problems. If the input series is completely random, or a "white noise" series, the CCF will reflect the underlying model. Otherwise, it first must be "prewhitened," a process in which a transformation is applied to the input series to make it random. The same transformation is also applied to the output series, and a new CCF is calculated which more clearly reflects the underlying relationship between the two series. Prewhitening was done in the present analysis.

The results of a transfer function analysis on each of the five FMS series are as follows. The CCF's for Procurement of Aircraft (2031) and Procurement of Ammunition (2034) are not statistically significant based on a Chi-square test of the first 40 coefficients. This means that a knowledge of the timing of specific orders does not help forecasting any more than knowledge of the average level of the obligation process.

A careful distinction should be made here. When the CCF is statistically not significant, one cannot predict the timing of specific obligations from the timing of specific orders. However, years having larger dollar amounts of orders still will have larger dollar amounts of obligations at the end of the year. If the time phased pattern of obligations (as opposed to the end of year amount) is not driven by the pattern of orders, perhaps it follows some other typical pattern. This idea is explored further below under ratio analysis.

The CCF for Procurement of Missiles (2032) does have overall significance at the 95 percent level with the largest single cross correlation coefficient (.63) at lag one month. This suggests that, for Procurement of Missiles, the delay between customer orders and their final obligation may often be about one month. Considering the number of steps in the obligation process, as described in Chapter II, these orders are being put on contract very fast.

There are several possible explanations for the short lag. Army items funded from 2032 often are produced by a single contractor, already under contract, and in production. A competitive contract may have been awarded recently, or competition may not be feasible (especially for a small customer increment). In this situation a simple contract modification or the use of an option clause would result in a quick obligation of funds.

Any approvals required from the State Department or the Office of the Secretary of Defense may have been arranged in advance. Another possibility is that offices which obligate 2032 funds are exceptionally well organized. Or they may delay entering customer orders into the 307-21 reports. In any case, the correlation between obligations at time t and orders at time (t-1) is much stronger than the correlation at other lags for Procurement of Missiles.

Calculation of the transfer function model for Missiles shows a medium-sized term at lag one month, and several small terms at longer lags. This suggests the possibility of forecasting one month ahead, which would be of very limited value in the present context. The long range 30 month forecast of obligations would require a 29 month forecast of orders; yet a univariate analysis of orders shows they are not forecastable with time series methods. However, if a method for forecasting customer orders becomes available (perhaps by polling likely customers), the use of transfer functions is worthy of further consideration for forecasting obligations of Procurement of Missiles.

The CCF for Procurement of Weapons and Tracked Combat Vehicles (2033) is significant at the 95 percent level, but the largest cross correlation (at lag five months) is only .38. Many orders funded from 2033 take five months to become obligations. Calculation of the transfer function model shows that only the coefficient at lag five is significant. However, it

is just barely significant at the 95 percent level, and its value of .23
explains only a small portion of the obligations of this appropriation.
Inspection of the forecasts with one month lead times showed an inability
to estimate accurately those months with unusually large obligations, such
as month 12. The use of transfer functions does not seem promising for
forecasting obligations of Procurement of Weapons and Tracked Combat Vehicles.

The CCF for Procurement of Ammunition (2034) is not significant at the
95 percent level of confidence. For this appropriation the best forecast
of obligations seems to be simply their average level, perhaps adjusted
for historical variations from month to month. Apparently, better knowledge
of the timing of orders for ammunition will not contribute more to a forecast
than knowledge of the average level of the obligation process.

The CCF for Procurement of Other (2035) is significant, but the only
significant cross correlation is at lag one month (.47). The discussion
under Procurement of Missiles (2032) about a forecast with a one month
lead time applies also to 2035. For this appropriation, the use of transfer
functions would be useful only if a good long range forecast of orders was
available. Orders for this appropriation appear to be random, so the
forecast of orders would have to be based on methods other than time series
analysis.

Time series analysis has produced generally disappointing results in
the present application. Only Procurement of Missiles and Procurement of

Other seem to be forecastable, given a time phased forecast of orders, and the forecast lead time for these would be only one month. Orders are not forecastable using time series methods. The most likely lag between orders and obligations can be determined for appropriations 2032, 2033, and 2035. The lags are respectively, one month, five months and one month. Monthly orders and monthly obligations both have distributions heavily skewed to the right; that is, there are a few very large months and many relatively small months. The square root transformation makes the data much more normally distributed, but does not improve forecasting. The implications of these findings are discussed in Chapter V.

E. RATIO ANALYSIS OF CUMULATIVE ORDERS AND OBLIGATIONS.

    1. Methodology.

        Transfer function analysis explored the idea that the high points and low points of one series (orders) could be used to forecast the highs and lows of another series (obligations). In a sense, it was based on a comparison of the shapes of the orders and obligations series. The relationship between the two shapes was found to be weak for most appropriations.

        This section will explore the possibility that there may be a typical shape for an obligation series, this shape being repeated from one budget cycle to the next, perhaps with minor variations. Since some years are larger than others, a size-free comparison requires that all amounts be expressed as ratios, using a selected base. Orders also will be analyzed using the same methods.

Data for this analysis were extracted from the report, "Status of Procurement Appropriation Customer Financial Plan," (the 307-21 report) as described in Chapter II (C), and reflect actual (as opposed to planned) amounts ordered and obligated. For each of the five procurement appropriations cumulative dollar amounts were recorded separately for orders (FMS, MAP, Other, and Total) and obligations (FMS, MAP, Other and Total). This data is presented in Appendices A through E.

For each fiscal year the orders series were standardized by dividing the dollar figure for each month by the base; namely, cumulative orders in month 12. Of course, FMS, MAP, Other and Total have different bases, as do different appropriations. Thus, the amount of FMS orders for FY 1978, month six, Procurement of Aircraft was expressed as .672, and the amount for month 19 as 1.012 (see Appendix A). In this way the dollar figures for orders were converted to ratios, with the orders for month 12 always having a value of 1.000. This procedure permits a comparison to be made of the shapes of the orders series.

Each obligation series was standardized using a similar process. The base for the obligation series was defined as cumulative month 12 orders, and not obligations, for two reasons. First, orders at month 12 are more readily determined in advance than obligations (if one knew obligations at month 12 he would be finished). Second, if obligations can be estimated with ratios, these ratios logically will be based on orders. For each of

the five procurement appropriations the monthly ratios were calculated for
orders (FMS, MAP, Other and Total), and obligations (same breakout). For
each month several ratios occur -- one for each fiscal year. For example,
for month 12, Procurement of Aircraft (Total), Fiscal Year 1976 the cumulative
orders in thousands were $161,722 (see Appendix A, page 4). This is the
base. The corresponding obligations were $115,075, giving a ratio of 0.712.
Thus, approximately 71 percent of that year's orders were obligated by the
end of the year. Ratios were calculated for other fiscal years and the
average of these, 0.706, is called the "factor" for month 12.

A graph of these factors (Appendix A, page 12) shows that the shape
of the obligation series is similar from one budget cycle to the next.
The degree of similarity is measured by the standard deviation of these
factors. Table 1 gives factors and 95 percent confidence limits (two
standard deviations) for total end of year obligations (FMS plus MAP
plus Other) for each appropriation. Other factors and standard deviations
are given in the appendices.

2. Application of Ratio Analysis to Forecasting.

The graphs show and the standard deviation columns confirm that the
shapes of the curves are indeed similar from year to year. This allows
obligations to be forecasted given an estimate of cumulative orders through
the end of month 12. The estimated orders times the factor for month i
(i = 1,2,...,36), is the obligation forecast for month i. The standard
deviations allow confidence intervals to be made, assuming a firm estimate
of orders is available.

TABLE 1

END OF YEAR OBLIGATIONS COMPARED TO END OF YEAR ORDERS

	FACTOR	TWO STANDARD DEVIATIONS (95% CONFIDENCE)
Procurement of Aircraft	.71	± .08
Procurement of Missiles	.84	± .16
Procurement of Weapons & T.C.V.	.77	± .24
Procurement of Ammunition	.64	± .38
Procurement of Other	.67	± .16

The confidence limits above reflect a "best case," in which end-of-year orders are exactly known. Ratio analysis shows that orders do not follow a stable pattern from year to year, however, so it is not possible to estimate the end of year orders accurately using, say, orders at month six together with a historical factor. Thus, actual forecasting accuracy is less than that implied by the appendices.

The problem, of course, is that orders are not exactly known. They are, however, estimated by the MSC's using nonstatistical methods. Although the MSC projections of orders are not always exact, they could be used with the factors developed here to provide an independent DARCOM obligation forecast. The MSC's also could use the factors to determine whether or not their own obligation forecasts were realistic.

Ratio analysis suggests that efforts to improve forecasting should be directed at making better forecasts of orders (perhaps by polling customers or developing customer profiles). It also suggests that statistical methods can give only approximate obligation forecasts, even if orders are exactly known.

This chapter began by distinguishing between goal determination and forecasting. Several curve fitting methods were described, including poly-nomial regression and multiple regression. Time series methods were used, but the timing of orders did not seem to drive the timing of obligations. Time series methods did not provide good forecasts of obligations. Ratio analysis described the typical monthly patterns followed by orders and obligations, but its use in forecasting required an outside estimate of year end orders. The analysis here suggests that the obligation process does not permit accurate statistical forecasting.

An accurate forecast is still required. If a statistical model cannot fully describe the relationship between orders and obligations, perhaps other factors are at work. The next chapter will explore some of the organizational and behavioral elements which may explain the statistical findings of this chapter.

CHAPTER IV

OTHER INFLUENCING FACTORS

A. <u>INTRODUCTION</u>.

The statistical models in Chapter III were not able to explain fully the obligation process. This process possibly violates some of the assumptions underlying the models. For example, time series and multiple regression both assume the average lag between orders and obligations is constant throughout the year. However, the velocity of paperwork through the system may be slower at the beginning of the year and faster at the end. The violation of assumptions would defeat time series analysis and multiple regression.

This chapter considers several factors which could influence the speed with which orders become obligations. The obligation process will be viewed as reflecting a complex system involving many parties and multiple goals. The chapter will consider how the interaction of these parties with each other and with their external environment can influence the obligation process. It suggests that some important nonstatistical factors are present, and may, in fact, dominate the statistical phenomena occurring. The relevance of these factors to forecasting obligations will be discussed, together with implications for the larger acquisition process.

B. GOALS, PARTIES, AND INTERACTIONS.

Organizational theorists, such as Eisenstadt (1956) and Lorsch and Lawrence (1972) say any organization (for example, DARCOM, an MSC, or a single procurement office) can be described usefully as a complex system having many parties and multiple goals. In the present context goals can be classified as major, subsidiary, procedural, and social. For example, DARCOM's major defense goals include the acquisition of hardware and the preservation of the mobilization base. Each organizational level has subsidiary objectives in support of the major goals, for example, obligation rates and processing time for orders. The system has incentives for the achievement of these objectives, as well as sanctions for not achieving them. Procedural goals refer to how things should be done, rather than what is to be done. For example, the Army prefers competitive contract awards even though other methods are faster. Social goals refer to considerations for special groups (for example, small business set asides), or for the general public (environmental constraints).

Each organizational unit or party comes into being as a means of implementing certain goals. In the Army different units have been created to represent different aspects of Army goals. The US Army Training and Doctrine Command (TRADOC) represents the needs of the equipment users. The Logistics Evaluation Agency (LEA) insures that the equipment is supportable in the field. DARCOM serves as the acquisition manager.

Within DARCOM different offices accomplish different subsidiary or procedural goals. Thus, the Program or Project Manager (PM) is responsible for

38

acquiring the hardware, but the Contracting Officer (CO) is responsible for dealing evenhandedly with defense corporations and following the procedures prescribed by the Defense Acquisition Regulation. The Special Assistant for Small Business at DARCOM promotes this social goal.

Different groups within any unit will have different conceptions of and attitudes toward the unit's multiple goals. For example, a PM and a CO may disagree over whether or not to satisfy an urgent military requirement by awarding a sole source contract. The PM, fearing his schedule will slip, and the troops will become vulnerable to some new countermeasure, may feel justified in insisting on a quick sole-source award to a known reliable contractor. The CO, fearing a legal protest from one of the contractors not selected, and the possibility of court action resulting in a judgement to repeat the whole award process, may insist on a more deliberate award process, such as formal advertising. Each party recognizes both goals, but each looks first to a different threat in the environment. Organizational theory calls attention to the presence of multiple goals, and emphasizes that the different attitudes toward these goals must be considered to understand why an organization functions the way it does.

Each organizational unit competes with other units for resources, authority, clients and protectors. Therefore, a unit depends on its environment and is subject to pressures. To succeed, an organization must interact successfully with its parent unit, its subordinate elements, and

with other groups which assist or serve as checks and balances. Budget
and procurement offices are the focus of many pressures, simply because
they function as keepers and distributors of resources.

C. INFLUENCE ON OBLIGATIONS.

The pressures in the system influence how and when funds are obligated.
The targets for high obligation rates and short processing times reflect
pressures which accelerate the process. The procedural goals and the
division of authority among several offices tend to delay the process.
In the example above, the PM's solution of a sole-source award could
result in the obligation of funds within the day. If the CO insisted on a
lengthy procedure such as competitive negotiation with formal source
selection, the funds might not be obligated for many months. The CO may
find it harder to resist the PM's arguments at the end of the year, if his
obligations were behind schedule. Thus, the lag between orders and obliga-
tions may be shorter at year end.

Figure 4 shows some of the parties involved in the obligation process
and some of their goals. Note that any proposed change to the process can
be analyzed in terms of the reactions of each party. For example, a new,
streamlined method of contracting may be seen by some as cutting red tape,
but seen by others as giving commanders a license to abuse the system. Even
the goal of an increased obligation rate may be opposed by some members of
Congress and by some segments of the public who oppose the specific systems
being acquired or the general level of foreign arms sales.

FIGURE 4

MULTIPLE PARTIES AND GOALS

IN THE OBLIGATION OF CUSTOMER FUNDS

Figure 4 also suggests why the obligation process is so hard to change. If the system is in equilibrium, then any major change will disturb this equilibrium. Depending on how the change affects achievement of various goals, some parties will want to implement it, but others will want to block or redirect it.

This chapter has suggested that the obligation process reflects a system with many parties and multiple goals. The variable speed with which the system moves toward achieving these goals results from the interaction between the parties, each with its own attitudes toward the multiple goals. Sometimes, for example, at year end, the pressures to accelerate the process are strong, but at other times this pressure is reduced. The resolution of differences between the parties takes time even under the best conditions, and each party is capable of reducing the obligation rate when its goals are not being met.

The interactions lead to pressures to achieve the targets, and these pressures may overwhelm the purely statistical relationships occurring. In particular, the existence of a lag which shortens as year end approaches could account for the weak forecasting ability of time series analysis. It could also account for the increasing slopes and year end peaks seen in the cumulative obligation curves in the appendices.

It is always difficult to explain why something does not correlate, and organizational theory may not be the only explanation. However, it serves to explain part of the process and account for the statistical findings.

The organizational factors are relevant to forecasting. If the process is, in fact, not primarily statistical, but goal seeking, then accurate statistical forecasting may not be possible, even with an accurate forecast of orders. Historical factors (as developed under ratio analysis, Chapter III) may give the best forecast because they reflect the historical resolution of the different pressures within the system.

It is not clear, however, that past goals were the most appropriate ones that could have been chosen. It seems very possible that better goal determination (as opposed to better forecasting) would improve the acquisition process. Improving goal determination is clearly beyond the scope of the present study, but the analysis of this chapter suggests that it is not something a single MSC, or even DARCOM can do alone. Each unit (HQ DA, DARCOM, and the MSC) must consider the other groups (superior, subordinate, and lateral) which interact with it.

CHAPTER V

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

A. FINDINGS.

This study has described the customer obligation process and analyzed the data for orders and obligations using several statistical techniques. Several findings can be summarized.

1. The relationship between the timing of orders and the timing of obligations is too weak to yield accurate time phased obligation forecasts, even if an accurate forecast of orders were available. For the Procurement of Missiles and the Procurement of Other appropriations the relationship is statistically significant, but not strong. A Box-Jenkins transfer function analysis shows that the timing of orders does not drive the timing of obligations.

2. Neither orders nor obligations can be forecasted from their own history. This expected finding was confirmed by a univariate time series analysis.

3. The most likely lag between orders and obligations is quantified for Procurement of Missiles (one month), Procurement of Weapons and Tracked Combat Vehicles (five months). and Procurement of Other (one month). The lags for Procurement of Aircraft and Procurement of Other could not be quantified with aggregated data, but a sampling of transactions might permit estimation of this lag.

4. Monthly orders and monthly obligations both have distributions skewed heavily to the right; that is, there are a few very large months and

many relatively small months. The square root transformation makes the data much more normally distributed.

5. Although the timing of orders does not drive the timing of obligations, the amount of orders at year end does influence the amount of obligations. Further, the shapes of the cumulative obligation curves are similar from year to year. Therefore, given an estimate of year-end orders, a time phased obligation forecast can be made. Factors for use in making these forecasts (including confidence limits) are provided for all five procurement appropriations for FMS, MAP, Other and Total. These forecasts, if based on a firm estimate of orders, are especially accurate for Procurement of Aircraft and Procurement of Other.

6. Statistical methods alone cannot provide accurate obligation forecasts. The organizational and behavioral aspects of the process also must be considered.

B. CONCLUSIONS.

Several conclusions can be drawn from the findings above.

1. The Army's present method, in which the total forecast is an aggregation of forecasts for individual customer orders and obligations, seems to be as good as any statistically-based forecast. In particular, time series methods (both univariate and transfer function analysis) cannot provide accurate forecasts of customer obligations for the procurement appropriations.

2. The timing of requirements is better known for the direct Army program, and statistical methods might permit good forecasting for some appropriations. However, for the Direct Army program the current obligation forecast is more accurate than the forecast for the customer program, and

it is not known whether time series methods would be superior to the present methods. In view of the cost of collecting data and the results for the customer program, it does not seem promising to use statistical methods for the direct Army program.

3. The sample size of 79 pairs of data points for each appropriation was adequate for the time series analysis. If more data become available, the autocorrelation functions and the cross correlation functions can be more accurately determined (for example, from .3 to .3192 at lag k), but the underlying relationships probably will not go from not significant to significant. There would be little advantage, then, to repeating this analysis at the end of the current year with more data.

4. Other forecasting methods, such as multiple regression, polynomial regression, autoregressive models and exponential smoothing, which are based on either curve fitting or are based on analysis of the time-phased relationships between orders and obligations, are not promising, for reasons discussed in the study. A sampling approach, in which individual orders were followed through the system, has been attempted by another office, but suitable data could not be found and so no conclusions are made about the value of that method.

5. An improved ability to forecast the few large orders and obligations would permit better forecasting of the total.

6. Non-statistical factors are influencing the obligation process, and may in fact dominate it. The obligation process was described as reflecting a complex system having many participants and multiple goals. The data can be viewed as reflecting the motion of this system toward its numerical obligation goals, rather than reflecting a statistical process. If this viewpoint is correct (and it cannot be proven), then improvements will follow more directly from changing the goal-determination process (between HQ DA, DARCOM, and the MSC's), than from better statistical forecasting.

C. RECOMMENDATIONS.

Several recommendations are made as follows:

1. Until a better method is found the Army should continue to refine and use its present methods to forecast customer obligations. Forecasts based on historical factors (ratio analysis) should be used by DARCOM and the MSC's to give an independent estimate and to judge the realism of the traditional forecasts.

2. The MSC's should emphasize forecasting customer orders on the basis of information peculiar to the customers. They should consider developing profiles of customer behavior (such as cancellation rates), surveys of customer buying intentions, and the intensive tracking of large orders through the system.

3. Because the statistical relationship between aggregated orders and obligations is so weak, no further parametric forecasting efforts

should be made for customer obligations. Consideration should be given to developing factors and rates, based on samples of individual cases.

4. Because of the cost of collecting and analyzing data, and because of the weak relationships found in the customer program, statistical forecasting as applied here should not be attempted for the direct Army program.

5. Efforts should be made to improve the process by which HQ DA, DARCOM, and the MSC's set obligation goals. These efforts should involve determining the linkage between methods and resources used, and obligation achievement. They also should consider the organizational factors influencing the obligation process.

6. This report considers for the first time the statistical, organizational, and behavioral factors influencing the obligation of customer funds. Any future attempts to improve forecasting or goal determination also should consider the implications of the nonstatistical factors.

BIBLIOGRAPHY

Box, G.E.P., and Cox, D.R. "An Analysis of Transformations."
Journal of the Royal Statistical Society, Series B, Volume 26,
1964, p. 211.

Box, G.E.P., and Jenkins, Gwilym M. Time Series Analysis, Forecasting
and Control. Revised ed. San Francisco: Holden-Day, 1976.

Brannon, Richard C., and Zabel, Wayne V. The Release and Obligation
of Army Procurement Funds. APRO Report 707. Ft Lee, Virginia:
Army Procurement Research Office, 1978.

Comptroller General of the United States. Analysis of Department of
Defense Unobligated Budget Authority. PAD 78-34. Washington, DC,
US General Accounting Office, January 1978.

Comshare, Incorporated. The Box System. Serial number 35730.
Bala-Cynwd, Pennsylvania: Comshare, Incorporated, 1976.

Eisenstadt, S.N., "Bureaucracy, Bureaucratization, and Debureaucrati-
zation." Administrative Science Quarterly, Volume III, 1959,
pp 302-320.

Helmer, Richard M., and Johansson. "An Exposition of the Box-Jenkins
Transfer Function Analysis with an Application to the Advertising-
Sales Relationship." Journal of Marketing Research, Volume XIV,
May 1977, pp 227-239.

Lorsch, J.W., and Lawrence, Paul R., eds. Managing Group and Intergroup
Relations. Homewood, Illinois: Richard D. Irwin, Inc., 1972.

Nelson, Charles R., Applied Time Series Analysis for Managerial Forecasting.
San Francisco: Holden-Day, Inc., 1973.

Perry, Virginia W. Analysis of the Projected FY 79 Army Procurement
Appropriation Customer Financial Plan. LSO Report 812. Ft Lee,
Virginia: Logistics Studies Office, 1979.

Tukey, John W. Exploratory Data Analysis. Reading, Massachusetts:
Addison-Wesley Publishing Company, 1977.

US Department of the Army. Status of Procurement Appropriation Customer Financial Plan Schedule 307-21. RCS CSAB-307. Indianapolis, Indiana: US Army Finance and Accounting Center. Directorate of Accounting Operations, May 1976 - September 1979.

US Department of Defense. Defense Security Assistance Agency. DOD Military Assistance and Sales Manual. DOD 5105.38-M (1978).

STUDY TEAM COMPOSITION

The study team consisted of the following individuals:

Richard C. Brannon, team leader, US Army Procurement Research Office (APRO) received his M.S. in mathematics in 1967 from Southern Illinois University. He also has a BA. in mathematics and statistics from the University of Missouri. Before coming to APRO as a Statistician, Mr. Brannon served as an Operations Research Analyst at Headquarters, Department of the Army, where he developed life cycle cost estimates for major weapons systems. He has worked as a computer systems analyst and has taught Calculus, Analytic Geometry and Algebra at the college level.

Uldis R. Poskus, Operations Research Analyst, US Army Logistics Studies Office (LSO), received his B.S. from the University of Cincinnati in 1966 and his MBA, also from the University of Cincinnati in 1971. Before joining LSO in May 1978, Mr. Poskus was an Operations Research Analyst and Principal Investigator (research) with the US Army Corps of Engineers Construction Engineering Research Laboratory (CERL) in Champaign, Illinois. From November 1978 to September 1979, Mr. Poskus served as an Operations Research Analyst with the Army Procurement Research Office.

Joyce A. Kozuch, Assistant Professor of Sociology at Virginia Commonwealth University volunteered valuable help at several points in the study. Dr. Kozuch received her Ph.D. from Northwestern University in 1974.

PROCUREMENT OF AIRCRAFT
FOREIGN MILITARY SALES ORDERS. IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	1891	541	0	844	962	0.030	0.036
2	.	.	.	2132	2667	337	1712	1220	0.059	0.037
3	.	.	.	2545	2072	732	1783	940	0.066	0.029
4	.	.	.	24024	3981	772	9592	12601	0.349	0.468
5	.	.	.	27432	14756	1603	14730	13115	0.521	0.478
6	.	.	.	27445	21614	2838	17299	12858	0.608	0.441
7	.	.	120704	27622	23289	4470	44026	52095	0.708	0.349
8	.	.	122694	27790	24624	5956	45260	52497	0.742	0.320
9	.	.	123752	27324	26303	5571	45738	52967	0.768	0.328
10	.	.	124430	27449	27346	5737	46241	53117	0.760	0.328
11	.	.	136190	27992	26733	6098	49753	58573	0.801	0.342
12	.	.	138485	27085	32173	20620	54591	56129	1.000	0.000
13	.	.	139316	26780	32502		66199	63385	1.002	0.011
14	.	.	147494	26426	32443		68921	68459	1.017	0.047
15	.	.	147857	24590	32377		68942	68405	1.019	0.044
16	.	.	141142	28611	32371		69042	68565	1.019	0.045
17	.	.	147749	24522	32373		68898	68366	1.018	0.045
18	.	.	147752	28572	32139		68823	68417	1.016	0.045
19	.	52906	139676	24549	32503		62924	52396	1.000	0.017
20	.	54571	139886	24582	32556		63399	52393	1.001	0.017
21	.	55736	138948	24600	32540		63756	51818	0.999	0.015
22	.	56492	126337	24506	32646		60594	45753	0.968	0.051
23	.	56522	126462	26537	29593		59505	45657	0.935	0.040
24	.	55716	125696	26352	28424		59297	46423	0.919	0.049
25	.	53177	125346	26372			67622	50109	0.932	0.058
26	.	53384	123156	26342			67527	49997	0.931	0.059
27	.	53217	123272	26320			67603	50051	0.931	0.058
28	.	53062	123362	26321			67747	50045	0.931	0.057
29	.	53201	122174	26326			67335	49401	0.927	0.063
30	54611	53500	122174	26320			67231	49583	0.928	0.062
31	54945	53025	123067	26320			65456	41413	0.933	0.055
32	61945	52940	123690	26320			65392	41337	0.932	0.056
33	56545	52704	123342	25444			65077	41489	0.915	0.034
34	56185		125444	26464			65019	42616	0.942	0.049
35	60285		125378	26501			64838	42510	0.942	0.052
36	57775	50561	122902	24867			63979	41735	0.903	0.022

PROCUREMENT OF AIRCRAFT
MILITARY ASSISTANCE PROGRAM ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	11184	0	195	3793	6402	0.373	0.333
2	.	.	.	11279	40022	196	17166	20555	0.818	0.448
3	.	.	.	11288	20021	200	10503	9934	0.601	0.093
4	.	.	.	11315	28591	404	13437	14213	0.864	0.190
5	.	.	.	15725	29421	424	15190	14506	0.973	0.075
6	.	.	.	15686	28306	426	14806	13961	0.962	0.081
7	.	.	1922	18102	28464	453	12235	13453	0.847	0.375
8	.	.	1964	18176	29479	464	12271	13456	0.857	0.380
9	.	.	2021	18214	28490	486	12300	13441	0.873	0.390
10	.	.	6410	14210	30080	487	13798	13118	1.055	0.101
11	.	.	6433	13247	30152	517	13837	13139	1.076	0.136
12	.	.	6522	17524	30171	405	13657	13091	1.000	0.000
13	.	.	6604	17491	30164	.	18086	11791	1.003	0.007
14	.	.	6618	17491	30164	.	18091	11784	1.004	0.009
15	.	.	6643	17496	30172	.	18104	11776	1.005	0.011
16	.	.	6675	17496	30234	.	18135	11792	1.008	0.013
17	.	.	6704	17494	30235	.	18144	11779	1.009	0.015
18	.	6536	6704	17500	30655	.	18153	11789	1.009	0.015
19	.	6595	6704	17500	30355	.	15274	11287	1.011	0.015
20	.	6643	6557	17500	30370	.	15256	11315	1.003	0.004
21	.	6643	6555	17500	30927	.	15381	11578	1.009	0.014
22	.	6542	6555	17502	31011	.	15402	11616	1.010	0.016
23	.	6545	6552	17502	31011	.	15415	11604	1.013	0.015
24	.	6546	6604	17502	31012	.	15431	11589	1.016	0.015
25	.	6547	6663	17499	.	.	10236	6293	1.009	0.015
26	.	6547	6661	17509	.	.	10238	6289	1.010	0.016
27	.	6547	6657	17509	.	.	10240	6295	1.010	0.015
28	.	6548	6644	17513	.	.	10241	6298	1.010	0.015
29	.	6548	6503	17505	.	.	10185	6334	0.997	0.002
30	.	6548	6503	17507	.	.	10186	6340	0.998	0.002
31	10402	6565	6474	17507	.	.	10358	5196	0.995	0.005
32	11317	6547	6496	17517	.	.	10474	5210	0.997	0.003
33	11121	6547	6497	17517	.	.	10426	5199	0.997	0.003
34	11122	6547	6497	17517	.	.	10426	5199	0.997	0.003
35	11122	6559	6498	17507	.	.	10422	5196	0.997	0.003
36	11053	6583	5716	15714	.	.	10017	5040	0.915	0.055

PROCUREMENT OF AIRCRAFT
OTHER ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	4936	189	212	1779	2734	0.150	0.238
2	.	.	.	5850	20345	5089	10428	8597	0.734	0.597
3	.	.	.	7030	11867	6410	8429	2976	0.596	0.231
4	.	.	.	7455	12797	12968	11073	3135	0.753	0.125
5	.	.	.	7679	13402	15505	12195	4050	0.821	0.142
6	.	.	.	8158	13941	15942	12680	4042	0.855	0.138
7	.	.	9257	9178	14222	16106	12191	3518	0.809	0.189
8	.	.	17312	11362	14623	16766	15016	2698	0.993	0.041
9	.	.	14135	11566	14320	16889	14228	2174	0.946	0.070
10	.	.	13312	12465	14221	16972	14243	1956	0.953	0.115
11	.	.	15838	13237	14194	17412	15170	1840	1.013	0.085
12	.	.	16708	11632	14407	17770	15129	2721	1.000	0.000
13	.	.	16993	11654	14452	.	14366	2671	1.007	0.008
14	.	.	17404	11312	14440	.	14385	3046	1.005	0.035
15	.	.	17784	11451	14515	.	14557	3127	1.017	0.039
16	.	.	16411	10942	13967	.	13787	2719	0.965	0.019
17	.	.	17611	11061	13969	.	14220	3272	0.992	0.054
18	.	.	15752	11190	13970	.	13637	2299	0.958	0.014
19	.	52032	15784	11226	13960	.	23416	19607	0.960	0.013
20	.	62774	14643	11224	14152	.	26209	24481	0.982	0.017
21	.	51649	16647	10887	13938	.	23280	19058	0.967	0.030
22	.	51650	16648	10924	13891	.	23278	19058	0.967	0.029
23	.	50743	19754	10928	13060	.	23671	18566	1.009	0.151
24	.	51027	15402	10912	12646	.	22498	19109	0.913	0.031
25	.	50925	15407	10912	.	.	25748	21919	0.930	0.011
26	.	51273	15303	10912	.	.	25863	22201	0.927	0.016
27	.	51274	15112	10913	.	.	25799	22247	0.921	0.024
28	.	51745	12829	11002	.	.	25032	22737	0.857	0.126
29	.	51667	12822	11006	.	.	25031	22737	0.857	0.126
30	.	51667	12821	10896	.	.	24994	22772	0.852	0.120
31	76432	51260	12815	10843	.	.	37838	31752	0.850	0.117
32	82324	51050	12409	10841	.	.	39306	34184	0.849	0.117
33	78224	51260	12915	10717	.	.	38252	32516	0.844	0.109
34	78604	51245	12793	10713	.	.	38339	32678	0.843	0.110
35	78711	51650	13424	10710	.	.	38525	32563	0.862	0.083
36	75734	47550	12642	8409	.	.	35994	31101	0.761	0.026

PROCUREMENT OF AIRCRAFT
TOTAL (FMS+MAP+OTHER) ORDERS, IN THOUSANDS,
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	18011	830	551	6464	10001	0.115	0.178
2	.	.	.	19261	63034	5622	29306	29995	0.436	0.348
3	.	.	.	20463	33940	7342	20715	13300	0.334	0.130
4	.	.	.	42794	45369	14144	34102	17332	0.572	0.199
5	.	.	.	51236	57579	17532	42116	21525	0.704	0.233
6	.	.	.	51289	63861	19206	44785	23027	0.746	0.221
7	.	.	131483	54902	65975	21049	68452	46405	0.798	0.184
8	.	.	141944	57328	67726	23188	72547	50024	0.844	0.177
9	.	.	139968	57104	69103	22946	72265	49152	0.843	0.180
10	.	.	144156	58124	71647	23196	74281	50861	0.864	0.187
11	.	.	154451	59476	73079	24027	79761	57015	0.902	0.194
12	.	.	151722	56241	76751	38795	83377	54485	1.000	0.000
13	.	.	152913	55925	77118	.	98652	56652	1.002	0.007
14	.	.	171916	55229	77047	.	101397	62038	1.016	0.042
15	.	.	172206	55537	77064	.	101602	62085	1.019	0.041
16	.	.	171231	55089	76572	.	100964	61794	1.012	0.042
17	.	.	172044	55127	76577	.	101263	62264	1.014	0.044
18	.	.	170215	55262	76364	.	100614	61193	1.010	0.037
19	.	112134	162154	55275	76878	.	101613	46677	0.996	0.011
20	.	123744	163128	56306	77078	.	104864	48259	0.999	0.014
21	.	115128	162150	54987	77405	.	102418	46921	0.996	0.016
22	.	115135	149540	54990	77448	.	99278	41696	0.971	0.043
23	.	114414	151220	54767	73764	.	98591	42971	0.958	0.021
24	.	114488	147754	54766	71882	.	97225	42021	0.941	0.030
25	.	110540	165454	54780	.		103607	45734	0.937	0.053
26	.	111004	145126	54753	.		103628	45636	0.935	0.054
27	.	111138	165048	54742	.		103643	45617	0.935	0.054
28	.	111385	142845	54836	.		103020	44596	0.929	0.065
29	.	111514	141604	54837	.		102552	43993	0.925	0.071
30	145945	110813	141494	54723	.		102411	44092	0.925	0.068
31	152260	110733	143851	54670	.		113652	42427	0.929	0.061
32	147890	110755	142995	54678	.		115172	44078	0.928	0.062
33	147921	107221	142730	53682	.		113756	43292	0.919	0.051
34	147921	107536	144986	54694	.		113784	43472	0.934	0.054
35	148047	107072	145300	54718	.		113784	43593	0.936	0.053
36	142515	106094	141309	50010	.		109982	43403	0.881	0.041

A-4

PROCUREMENT OF AIRCRAFT
FOREIGN MILITARY SALES OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	•	•	•	0	0	0	0	0	0.000	0.000
2	•	•	•	16	4	0	7	8	0.000	0.000
3	•	•	•	1098	82	0	393	612	0.014	0.923
4	•	•	•	1227	188	136	517	615	0.019	0.023
5	•	•	•	1240	4485	182	1969	2242	0.065	0.067
6	•	•	•	5253	4586	183	4684	4233	0.157	0.133
7	•	•	•	5797	8903	260	12313	15081	0.188	0.120
8	•	•	34230	6559	10459	305	13566	16128	0.212	0.136
9	•	•	36930	9406	10438	321	27356	41467	0.334	0.257
10	•	•	39140	0454	11250	1352	27997	41427	0.354	0.238
11	•	•	42777	10000	11388	1677	28332	41509	0.364	0.233
12	•	•	81262	20195	21668	10325	37918	41355	0.660	0.110
13	•	•	94496	20178	12669	•	44236	48302	0.620	0.196
14	•	•	97941	22002	12635	•	44987	48152	0.643	0.221
15	•	•	100324	21148	22138	•	48570	46599	0.737	0.047
16	•	•	102375	22438	22177	•	49329	46803	0.755	0.070
17	•	•	103372	22343	22038	•	49796	47774	0.757	0.071
18	•	•	104550	22515	24213	•	50481	46981	0.780	0.044
19	•	20073	104721	22472	24262	•	44114	43724	0.792	0.038
20	•	20944	109650	22533	24321	•	44465	43751	0.794	0.038
21	•	22754	110059	22532	25530	•	45368	43547	0.808	0.021
22	•	22174	110657	22820	25882	•	45535	43578	0.814	0.025
23	•	22704	110770	25052	25699	•	45646	43534	0.817	0.030
24	•	23645	111411	24092	24546	•	46518	43804	0.842	0.042
25	•	23735	112202	24376			53438	50892	0.855	0.063
26	•	23331	112002	24372			53403	50752	0.854	0.064
27	•	9002x	112772	24407			53911	50417	0.855	0.065
28	•	25129	112174	24574			54010	50344	0.859	0.069
29	•	25541	112298	24593			54586	51131	0.864	0.062
30	•	25947	111221	24614			53828	49706	0.856	0.075
31	47421	25958	111553	24316			52762	40709	0.851	0.066
32	49673	25790	111420	24436			52828	40735	0.853	0.069
33	50004	25864	112940	24503			53340	41431	0.860	0.063
34	5019x	25880	113262	24366			53469	41569	0.859	0.059
35	51242	25433	113508	24238			53705	41743	0.857	0.053
36	51345	27102	115248	24401			54536	42254	0.867	0.049

A-5

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	63	0	0	21	36	0.001	0.002
3	.	.	.	9392	9050	0	6147	5326	0.279	0.269
4	.	.	.	9396	18196	0	9197	9100	0.380	0.331
5	.	.	.	9427	9146	0	6191	5363	0.280	0.270
6	.	.	.	9533	9316	0	6283	5442	0.284	0.273
7	.	.	128	13996	9305	0	5857	6958	0.282	0.372
8	.	.	128	14208	13784	0	7030	8046	0.322	0.388
9	.	.	1153	14364	13620	8	7336	7818	0.369	0.351
10	.	.	1153	14364	15006	8	7633	8161	0.378	0.355
11	.	.	1140	14232	15216	9	7659	8182	0.380	0.351
12	.	.	3107	14620	26657	75	11265	11979	0.618	0.320
13	.	.	3781	14649	26685	.	15038	11457	0.767	0.164
14	.	.	3960	14777	24730	.	15136	11419	0.776	0.156
15	.	.	4518	14742	26762	.	15341	11134	0.807	0.102
16	.	.	4608	14742	24780	.	15377	11100	0.812	0.094
17	.	.	4038	14744	26490	.	15291	10936	0.810	0.088
18	.	.	4631	14784	26509	.	15308	10948	0.811	0.089
19	.	3207	4775	15100	26509	.	12395	10788	0.823	0.081
20	.	2750	4222	15113	26636	.	12305	10986	0.823	0.087
21	.	4793	4726	15113	26676	.	12827	10443	0.823	0.087
22	.	4032	4172	15122	26779	.	12876	10468	0.827	0.084
23	.	4664	4643	15147	27232	.	12972	10696	0.826	0.101
24	.	4771	4738	15303	27597	.	13102	10868	0.838	0.099
25	.	4720	4740	15406	.	.	8311	6144	0.803	0.107
26	.	5098	4748	15440	.	.	8425	6077	0.804	0.109
27	.	5097	4813	15502	.	.	8471	6091	0.811	0.104
28	.	5232	4813	15502	.	.	8516	6054	0.811	0.104
29	.	5631	4821	15502	.	.	8518	6052	0.812	0.103
30	.	5210	4834	15502	.	.	8515	6054	0.813	0.102
31	6653	4872	4834	15489	.	.	7962	5089	0.812	0.101
32	7053	4872	4892	15505	.	.	8081	5054	0.817	0.101
33	6713	4882	4904	15517	.	.	8004	5082	0.818	0.095
34	6704	4895	4934	15545	.	.	8017	5090	0.821	0.093
35	6702	4874	4939	15545	.	.	9015	5091	0.822	0.092
36	6717	4917	4940	15634	.	.	8052	5125	0.824	0.096

PROCUREMENT OF AIRCRAFT
OTHER OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	0	0	0	0	0	0.000	0.000
3	.	.	.	407	215	0	207	204	0.017	0.018
4	.	.	.	408	214	9800	3474	5479	0.200	0.304
5	.	.	.	408	214	13060	4561	7361	0.262	0.410
6	.	.	.	1950	9019	13760	9243	5943	0.523	0.316
7	.	.	.	1951	9041	13760	5991	5469	0.440	0.307
8	.	.	.	2275	9155	13780	7888	4838	0.496	0.259
9	.	.	.	2344	9290	14383	8402	4964	0.528	0.261
10	.	.	3610	3906	9503	14397	8882	4355	0.567	0.210
11	.	.	6340	4285	9528	14513	9539	4180	0.609	0.186
12	.	.	7590	4281	9862	15161	10296	4566	0.654	0.205
13	.	.	7723	4883	9765	.	8219	2892	0.566	0.132
14	.	.	9628	5079	9828	.	8304	2794	0.573	0.125
15	.	.	11078	5112	9819	.	7827	2435	0.544	0.124
16	.	.	10007	5126	10380	.	9132	2708	0.564	0.143
17	.	.	10004	5130	10391	.	8069	2684	0.561	0.144
18	.	.	8550	5415	10384	.	8387	2624	0.582	0.129
19	.	46194	8898	5484	10401	.	17885	18996	0.586	0.126
20	.	52447	8607	5269	10844	.	20260	23578	0.591	0.151
21	.	53354	9353	5238	10917	.	18030	19041	0.594	0.155
22	.	45297	9456	5310	10481	.	17929	19047	0.587	0.136
23	.	45323	9441	5413	10845	.	18047	18994	0.598	0.145
24	.	45308	9608	5515	11517	.	18212	18896	0.614	0.167
25	.	45174	9628	5516	.	.	20401	22410	0.522	0.067
26	.	46207	9006	5537	.	.	20440	22406	0.525	0.069
27	.	45182	9507	5717	.	.	20486	22336	0.532	0.052
28	.	45142	9516	5721	.	.	20488	22301	0.533	0.059
29	.	45153	9576	5053	.	.	20270	22531	0.505	0.099
30	.	46334	9558	5053	.	.	20338	22629	0.505	0.100
31	51268	46536	9602	5091	.	.	28138	24126	0.508	0.099
32	56796	45737	9603	5089	.	.	29569	26025	0.508	0.099
33	51690	45737	9026	5136	.	.	28292	24311	0.508	0.099
34	51637	45737	9656	5135	.	.	28263	24310	0.506	0.094
35	51379	46726	9654	5135	.	.	29186	24246	0.505	0.092
36	50910	46609	9606	5978	.	.	28246	23795	0.541	0.038

A-7

PROCUREMENT OF AIRCRAFT
TOTAL(PMS+MAP+OTHER) OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	79	4	0	28	45	0.000	0.001
3	.	.	.	10897	9347	0	6748	5895	0.105	0.098
4	.	.	.	11031	18598	9936	13188	4717	0.232	0.031
5	.	.	.	11075	13845	13242	12721	1457	0.240	0.089
6	.	.	.	16766	26921	13943	19210	6825	0.336	0.033
7	.	.	37628	21744	27249	14020	25160	9926	0.334	0.069
8	.	.	43395	23052	33398	14085	28483	12694	0.369	0.074
9	.	.	77723	26194	33548	14712	43094	37365	0.472	0.096
10	.	.	98073	27860	35759	15757	44512	37032	0.494	0.086
11	.	.	101270	28517	36132	16199	45530	38057	0.505	0.089
12	.	.	115075	39091	58187	25561	59479	39407	0.706	0.041
13	.	.	113631	39730	49119	.	67493	40231	0.683	0.037
14	.	.	114225	41858	49193	.	68426	39835	0.697	0.052
15	.	.	115443	41052	58719	.	71738	38867	0.736	0.026
16	.	.	116570	42307	59337	.	72838	39072	0.749	0.025
17	.	.	116630	42264	58919	.	73156	39960	0.750	0.018
18	.	.	117715	42709	61106	.	74177	39653	0.763	0.031
19	.	69479	163871	43056	61172	.	74395	34780	0.776	0.018
20	.	79142	124652	42915	61801	.	77030	34790	0.779	0.023
21	.	73905	124731	42483	63123	.	74226	34961	0.786	0.032
22	.	73894	165270	43252	62942	.	75341	34997	0.788	0.028
23	.	74035	165150	43617	63776	.	76664	34725	0.793	0.032
24	.	74324	166435	44910	65660	.	77832	34673	0.812	0.039
25	.	74549	166442	45298	.	.	82150	41093	0.794	0.017
26	.	75126	126530	45349	.	.	82268	40960	0.794	0.018
27	.	76474	126496	45627	.	.	82867	40811	0.797	0.021
28	.	76590	126556	45797	.	.	83014	40749	0.798	0.022
29	.	76725	128049	45148	.	.	83374	41825	0.797	0.008
30	.	77193	125681	45169	.	.	82681	40536	0.790	0.018
31	167342	77356	125843	44896	.	.	88862	35470	0.788	0.014
32	113522	77407	125451	45030	.	.	90478	36632	0.790	0.015
33	108457	77483	127450	45156	.	.	89637	36103	0.795	0.010
34	108739	77502	127691	45076	.	.	89750	36263	0.795	0.010
35	109333	77443	127929	44918	.	.	89906	36526	0.795	0.005
36	109072	75028	129574	46013	.	.	90847	36511	0.810	0.012

PROCUREMENT OF AIRCRAFT, ORDERS IN THOUSANDS, CUMULATIVE

ORDERS

MONTHS FROM INCEPTION

A-9
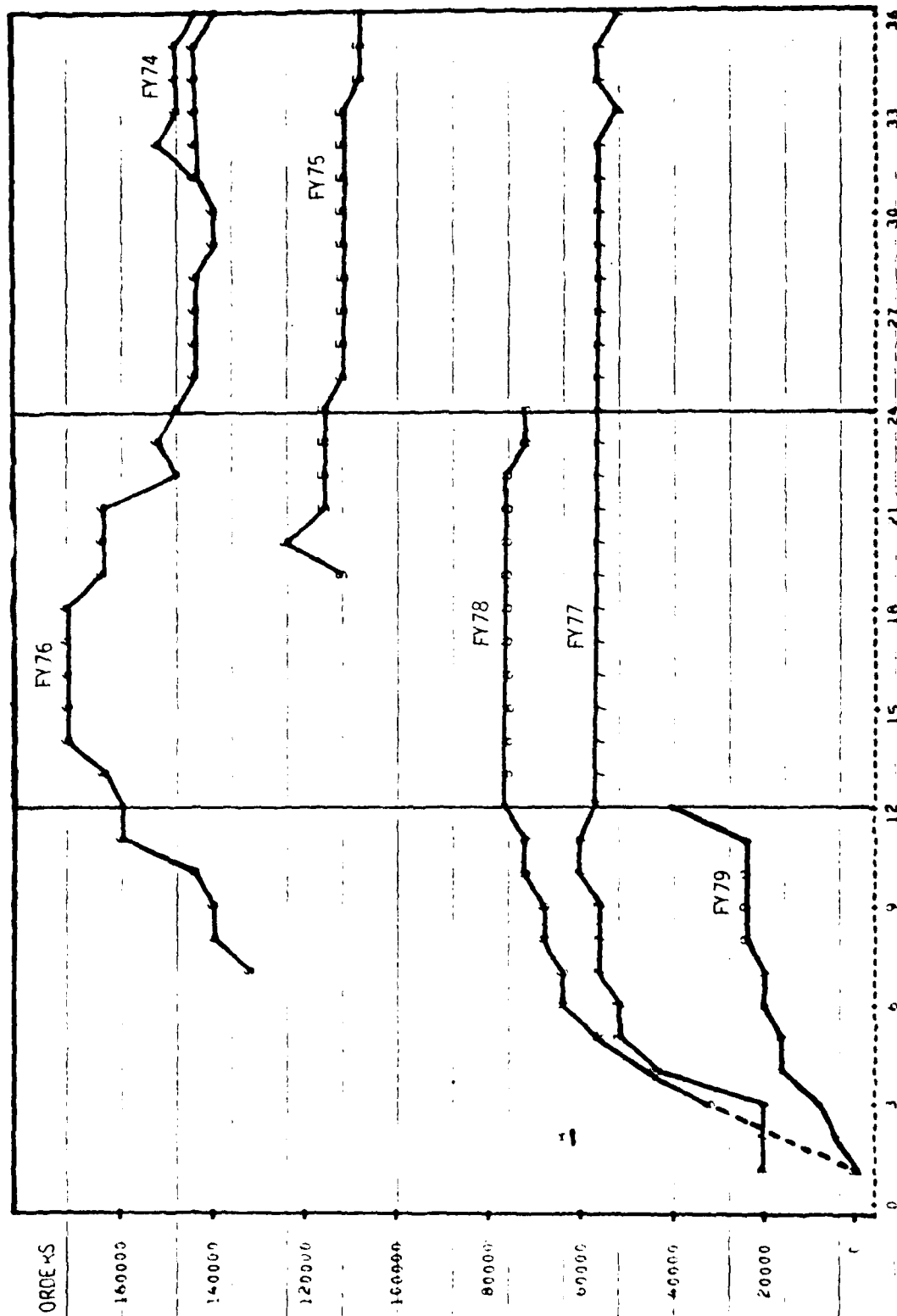
PROCUREMENT OF AIRCRAFT, ORDER FACTORS
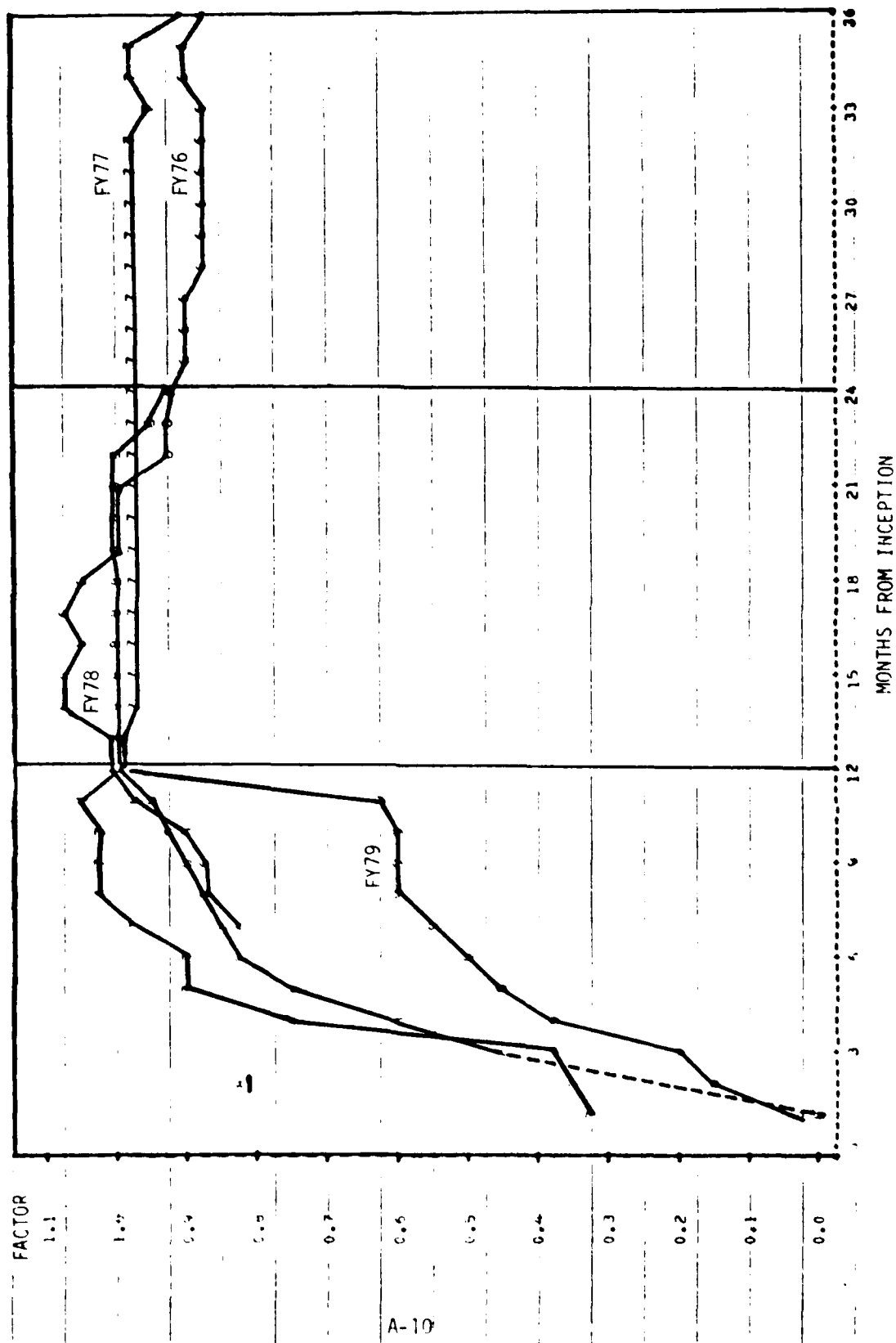
A-10

PROCUREMENT OF AIRCRAFT, OBLIGATIONS IN THOUSANDS, CUMULATIVE
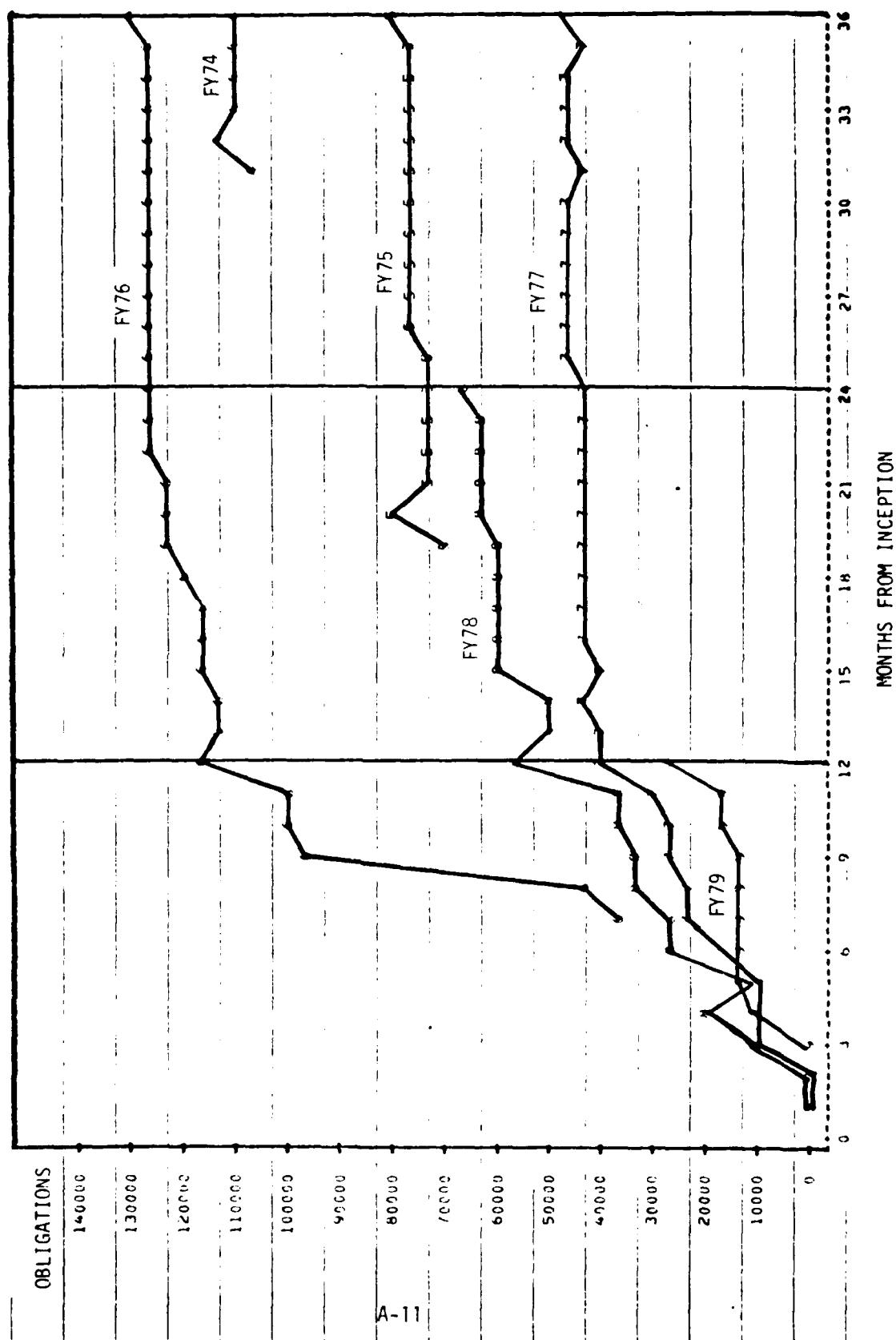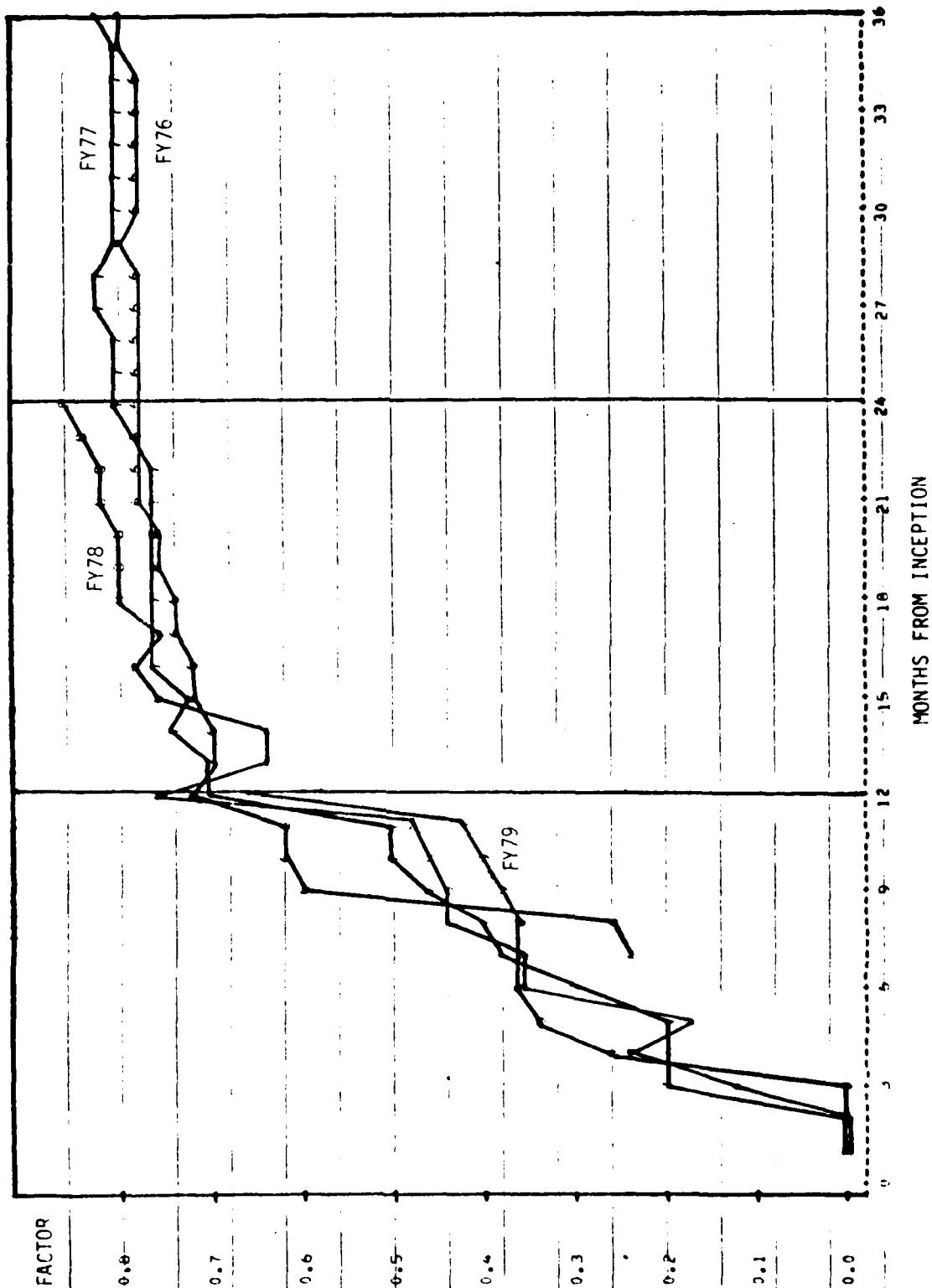
OBLIGATIONS — FY74, FY75, FY76, FY77, FY78, FY79

MONTHS FROM INCEPTION

A-11

PROCUREMENT OF AIRCRAFT, OBLIGATION FACTORS

FACTOR

FY77
FY76
FY78
FY79

MONTHS FROM INCEPTION

A-12

PROCUREMENT OF MISSILES
FOREIGN MILITARY SALES ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	164	120731	394	40430	69543	0.104	0.179
2	.	.	.	112675	228493	30983	124050	99245	0.402	0.269
3	.	.	.	120483	217509	198682	178891	51452	0.573	0.022
4	.	.	.	153806	239300	214065	202390	43926	0.659	0.050
5	.	.	.	160127	319954	214125	231402	81302	0.738	0.090
6	.	.	.	168571	336220	247501	250764	83872	0.799	0.062
7	.	.	442224	192950	349540	257714	320607	125445	0.850	0.060
8	.	.	959196	204110	365298	270643	452312	350879	1.092	0.384
9	.	.	516967	205982	370879	285046	344719	133120	0.915	0.050
10	.	.	526561	216399	380813	295906	354920	132667	0.965	0.057
11	.	.	551477	262161	385123	315175	378485	125844	1.027	0.130
12	.	.	583751	215107	387770	331983	379653	153915	1.000	0.000
13	.	.	599960	212934	386795	.	389896	178533	0.988	0.011
14	.	.	571003	213796	387679	.	390826	178624	0.991	0.011
15	.	.	570894	213632	387610	.	390712	178651	0.990	0.011
16	.	.	570748	213453	386659	.	390353	178776	0.989	0.010
17	.	.	566745	212023	386679	.	384489	177378	0.985	0.013
18	.	.	557177	209585	389759	.	388818	178764	0.984	0.019
19	.	869430	566544	210286	390535	.	514199	289364	0.985	0.019
20	.	1779151	570792	209328	392050	.	737580	709242	0.987	0.021
21	.	884633	572246	209049	391191	.	514280	288004	0.987	0.019
22	.	883078	565099	204240	390784	.	511950	287676	0.981	0.023
23	.	882462	449880	207446	385717	.	481376	286386	0.910	0.122
24	.	882459	445553	209473	386021	.	480877	285875	0.911	0.128
25	.	882459	432774	208898	.	.	507980	342927	0.856	0.162
26	.	892176	434846	209438	.	.	508433	342411	0.859	0.162
27	.	892089	433528	210198	.	.	503605	342179	0.860	0.166
28	.	883036	433346	209964	.	.	508782	342818	0.859	0.165
29	.	882571	433443	209821	.	.	508745	342835	0.859	0.165
30	.	878802	433231	209703	.	.	507245	340635	0.859	0.165
31	333255	878604	433327	209710	.	.	463774	291411	0.859	0.164
32	666796	873343	431407	208584	.	.	545034	287939	0.854	0.163
33	333955	874740	433446	208197	.	.	462585	289816	0.855	0.159
34	333916	798345	432936	207884	.	.	443269	254001	0.854	0.158
35	334041	800726	426444	206261	.	.	441868	255704	0.845	0.161
36	332968	806408	431647	211348	.	.	445593	256864	0.861	0.172

PROCUREMENT OF MISSILES
MILITARY ASSISTANCE PROGRAM ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	•	•	•	0	292	0	97	169	0.007	0.011
2				1	442	942	462	471	0.041	0.047
3				1	429	950	460	475	0.041	0.048
4				1	8137	1145	3094	4404	0.223	0.293
5				15	9245	3106	4122	4698	0.315	0.311
6				121	11231	3331	4894	5718	0.385	0.355
7			10271	121	11244	3743	6345	5320	0.411	0.269
8			23243	121	11326	3965	9664	10177	0.558	0.417
9			12978	121	11738	4100	7234	6156	0.458	0.310
10			12638	121	12003	4109	7218	6118	0.459	0.315
11			14577	160	11883	6830	8351	6326	0.549	0.321
12			23047	1954	14680	10114	12449	8811	1.000	0.000
13			19185	1954	15669	•	12269	9105	0.967	0.121
14			19651	1922	15704	•	12292	9154	0.963	0.119
15			19264	1938	15706	•	12303	9151	0.966	0.119
16			19310	1944	15770	•	12341	9177	0.969	0.120
17			19541	1946	15740	•	12409	9258	0.972	0.114
18			19534	1945	15756	•	12412	9259	0.972	0.115
19		2213	19533	1960	15789		9874	9122	0.975	0.117
20		4425	19501	1960	15793		10420	8541	0.975	0.117
21		2194	19444	1960	15811		9850	9103	0.975	0.119
22		2173	14452	1961	15811		9849	9109	0.975	0.119
23		2173	19480	1961	15745		9840	9104	0.974	0.117
24		2254	20033	1967	14630		9721	9061	0.957	0.077
25		2254	20033	1967	•		8085	10349	0.938	0.097
26		2254	20033	1967	•		8085	10349	0.938	0.097
27		2256	20033	1967	•		8085	10348	0.938	0.097
28		2256	20036	1967	•		8084	10346	0.938	0.097
29		2256	20030	1967	•		8084	10346	0.938	0.097
30		2256	20083	1967	•		8102	10377	0.939	0.096
31	6037	2256	20080	1967	•		7585	8534	0.939	0.096
32	11937	2256	20080	1967	•		9060	8686	0.939	0.096
33	5900	2256	20080	1967	•		7551	8542	0.939	0.096
34	5900	2256	20080	1967	•		7551	8542	0.939	0.096
35	5902	2256	20080	1967	•		7551	8542	0.939	0.096
36	5902	2250	20001	1757	•		7480	8549	0.884	0.022

PROCUREMENT OF MISSILES
OTHER ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	•	•	•	30371	68606	1	32993	34379	0.485	0.441
2	•	•	•	62017	95758	24394	60723	35700	1.032	0.304
3	•	•	•	62536	82384	25686	56869	28771	0.991	0.255
4	•	•	•	55541	82459	24126	54042	29195	0.932	0.225
5	•	•	•	53500	83003	29467	55323	26815	0.970	0.128
6	•	•	•	53659	82612	30052	55508	26429	0.976	0.119
7	•	•	54576	54284	83521	30288	55667	21780	0.958	0.113
8	•	•	104427	51753	76726	31336	67411	33825	1.153	0.410
9	•	•	53122	51799	75320	31385	52907	17952	0.922	0.072
10	•	•	53123	51506	75454	32978	53265	17388	0.932	0.064
11	•	•	53346	50715	75750	35128	56245	17397	0.985	0.027
12	•	•	52305	51222	79523	35818	57217	18415	1.000	0.000
13	•	67585	52823	51220	79092	•	64378	14001	1.001	0.007
14	•	137713	52702	51000	79289	•	64330	14215	1.000	0.006
15	•	69606	53240	51091	76890	•	63740	12907	0.993	0.024
16	•	69607	54332	50984	76840	•	64052	12930	0.998	0.033
17	•	69607	54384	51378	76681	•	64214	12752	1.001	0.033
18	•	70138	54254	51341	77021	•	64205	12840	1.001	0.031
19	•	70148	54654	51440	77046	•	65657	10628	1.001	0.031
20	•	73090	61770	51439	77047	•	82492	39571	0.988	0.018
21	•	70080	59589	51430	77064	•	64472	11269	0.977	0.025
22	•	70076	59589	51464	76858	•	64425	11187	0.976	0.025
23	•	69954	59625	51289	76879	•	64482	11303	0.975	0.023
24	•	69495	59608	51291	76872	•	64530	11276	0.976	0.022
25	•	69486	59666	51291	•	•	60416	9412	0.981	0.029
26	•	69486	59346	51291	•	•	60252	9424	0.977	0.034
27	•	69531	59626	50245	•	•	59982	9920	0.969	0.017
28	•	69561	59625	50068	•	•	59882	9945	0.967	0.014
29	•	69557	56829	50072	•	•	58799	9860	0.945	0.046
30	•	69558	56842	50057	•	•	58795	9861	0.945	0.046
31	53203	69541	56862	50019	•	•	57393	8533	0.945	0.045
32	106406		56941	49950	•	•	70707	25141	0.945	0.043
33	52814		56940	49761	•	•	57269	8707	0.943	0.041
34	52822		56715	49275	•	•	57092	8848	0.936	0.037
35	52814		56758	49270	•	•	57100	8851	0.936	0.036
36	53004		56644	49198	•	•	57107	8835	0.935	0.036

PROCUREMENT OF MISSILES
TOTAL(FMS+MAP+OTHER) ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	30535	189631	343	73520	101678	0.169	0.202
2	.	.	.	174693	326693	56319	185235	134497	0.491	0.297
3	.	.	.	183020	300322	225318	236220	59406	0.634	0.044
4	.	.	.	209348	329696	239336	259527	62759	0.699	0.075
5	.	.	.	213642	412202	246698	290847	106388	0.768	0.104
6	.	.	.	223351	430263	280844	311166	107213	0.822	0.075
7	.	.	547071	247355	444305	291745	382619	138328	0.858	0.076
8	.	.	110224	255984	453350	305944	529386	391002	1.088	0.379
9	.	.	543067	257902	457436	310531	404860	145239	0.908	0.056
10	.	.	592322	268020	468270	332963	415403	144461	0.934	0.060
11	.	.	529396	313036	472756	357133	443080	141294	1.008	0.107
12	.	.	599103	266283	481773	377915	449319	170532	1.000	0.000
13	.	.	551948	266103	481556	.	466544	193368	0.988	0.013
14	.	.	552956	266718	482672	.	467449	193568	0.990	0.013
15	.	.	553398	266661	480606	.	466755	193719	0.989	0.011
16	.	.	554530	266381	479269	.	465747	194407	0.989	0.009
17	.	.	550904	265347	479300	.	465112	193063	0.985	0.011
18	.	.	550087	262871	462536	.	465435	194577	0.985	0.015
19	.	350432	620031	263686	463570	.	549730	294124	0.986	0.016
20	.	322295	550225	292727	444490	.	830492	745136	0.987	0.017
21	.	956023	551276	262448	484054	.	589604	292502	0.985	0.017
22	.	955654	544140	261645	443453	.	546224	291976	0.980	0.021
23	.	954771	528985	260696	473341	.	555698	290392	0.918	0.111
24	.	954481	525394	262731	477623	.	555120	289922	0.918	0.116
25	.	954013	512673	262156	.	.	576481	350611	0.872	0.149
26	.	954410	514363	262426	.	.	577170	350165	0.874	0.149
27	.	954442	513171	252410	.	.	575673	350346	0.873	0.149
28	.	955640	513001	261999	.	.	576749	350992	0.872	0.148
29	.	954772	513020	261690	.	.	575628	351020	0.869	0.151
30	.	950050	510101	261727	.	.	574142	348838	0.869	0.151
31	342495	950540	524621	261696	.	.	528752	298963	0.869	0.150
32	745133	950542	524404	260501	.	.	624801	302534	0.865	0.149
33	392659	949952	510101	259925	.	.	527405	297587	0.866	0.146
34	492768	510102	446019	259926	.	.	519912	262303	0.864	0.144
35	512262	507272	521605	257498	.	.	506519	263903	0.856	0.147
36	393874	878262	504332	262303	.	.	510180	265134	0.869	0.154

B-4

PROCUREMENT OF MISSILES
FOREIGN MILITARY SALES OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	16694	394	5696	9527	0.015	0.025
2	.	.	.	14877	86752	14525	38718	41599	0.112	0.097
3	.	.	.	37290	120783	54167	70747	44147	0.216	0.083
4	.	.	.	44590	136196	58237	79674	49423	0.245	0.094
5	.	.	.	56711	165582	70564	97619	59264	0.301	0.112
6	.	.	.	61929	234155	81559	125881	94280	0.379	0.196
7	.	.	153658	72404	244389	92799	143313	77910	0.382	0.168
8	.	.	334358	91491	269047	127363	205567	115107	0.519	0.142
9	.	.	204055	115290	285194	190931	198869	69589	0.549	0.159
10	.	.	260100	125849	309835	195771	222889	79784	0.605	0.146
11	.	.	269567	135401	325163	226625	239189	80092	0.653	0.155
12	.	.	418163	174725	355586	293060	310384	103864	0.832	0.089
13	.	.	344105	176179	359445	.	293243	101670	0.778	0.172
14	.	.	358148	215523	361804	.	311825	83420	0.850	0.207
15	.	.	383742	203918	361865	.	316508	98118	0.846	0.164
16	.	.	394198	204468	364538	.	321068	102062	0.855	0.156
17	.	.	392817	205953	366943	.	321871	101224	0.859	0.161
18	.	.	391522	204725	370257	.	322168	102263	0.859	0.163
19	.	679515	396994	196947	375230	.	412172	199490	0.854	0.153
20	.	1361474	388435	196821	375924	.	580664	527848	0.850	0.162
21	.	690025	390462	198052	373428	.	413192	204502	0.851	0.159
22	.	693028	393571	198315	373172	.	414672	205584	0.853	0.156
23	.	695018	398656	199222	374121	.	416754	205667	0.858	0.153
24	.	719544	405553	199577	375653	.	425082	216322	0.864	0.148
25	.	721566	405198	194479	.	.	442014	262884	0.811	0.165
26	.	732478	416380	199500	.	.	449453	268024	0.820	0.151
27	.	737900	411443	200041	.	.	449795	270973	0.817	0.159
28	.	737246	411336	198201	.	.	449594	272544	0.813	0.153
29	.	741278	410914	199665	.	.	450620	272979	0.816	0.159
30	.	743273	410431	200697	.	.	451467	273606	0.818	0.163
31	272670	747426	405435	201390	.	.	406730	242358	0.815	0.171
32	545966	752712	403442	202286	.	.	476102	232127	0.816	0.176
33	274657	754058	404039	202925	.	.	408920	244680	0.818	0.178
34	274610	756692	404599	201685	.	.	409397	246271	0.815	0.173
35	277256	757999	404504	202088	.	.	410962	247234	0.816	0.174
36	274530	780151	404502	201287	.	.	416368	256556	0.814	0.172

PROCUREMENT OF MISSILES
MILITARY ASSISTANCE PROGRAM OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	0	2	245	82	141	0.008	0.014
3	.	.	.	0	2	245	82	141	0.008	0.014
4	.	.	.	0	178	253	144	130	0.012	0.013
5	.	.	.	14	2901	267	1061	1599	0.077	0.105
6	.	.	.	57	5214	275	1849	2917	0.137	0.189
7	.	.	410	89	6309	1602	2028	2941	0.160	0.191
8	.	.	1353	89	7027	1911	2595	3051	0.193	0.201
9	.	.	1299	89	7575	1923	2722	3324	0.202	0.219
10	.	.	1317	94	8032	2057	2876	3532	0.214	0.233
11	.	.	1519	77	8755	3674	3506	3799	0.266	0.265
12	.	.	13083	1548	9228	5314	7293	4973	0.628	0.117
13	.	.	7302	1549	9909	.	6253	4278	0.595	0.248
14	.	.	10201	1527	10133	.	7287	4988	0.638	0.175
15	.	.	10905	1538	10247	.	7563	5228	0.653	0.162
16	.	.	10874	1539	10328	.	7580	5239	0.654	0.164
17	.	.	11145	1760	10498	.	7801	5242	0.700	0.209
18	.	.	11140	1754	10550	.	7815	5257	0.700	0.208
19	.	1032	11324	1754	12280	.	6598	6030	0.742	0.219
20	.	2980	11672	1770	12721	.	7286	5708	0.760	0.220
21	.	1919	11787	1769	12733	.	7052	6026	0.761	0.217
22	.	1907	11786	1769	12624	.	7021	5995	0.759	0.216
23	.	1907	11865	1770	12619	.	7040	6015	0.760	0.214
24	.	2025	11942	1770	12931	.	7167	6099	0.768	0.217
25	.	1981	11932	1771	.	.	5231	5805	0.712	0.275
26	.	1986	11224	1771	.	.	5229	5802	0.712	0.275
27	.	1990	11430	1769	.	.	5230	5804	0.711	0.274
28	.	1990	11931	1767	.	.	5229	5805	0.711	0.273
29	.	1990	11942	1767	.	.	5233	5811	0.711	0.273
30	.	1990	11941	1767	.	.	5233	5811	0.711	0.273
31	4964	1988	11941	1767	.	.	5165	4747	0.711	0.273
32	9928	1987	11917	1767	.	.	6400	5286	0.711	0.274
33	4965	1988	11924	1767	.	.	5161	4739	0.711	0.274
34	4964	1988	11926	1729	.	.	5152	4749	0.701	0.260
35	4969	1988	11900	1761	.	.	5155	4729	0.709	0.272
36	4973	1988	11905	1760	.	.	5157	4731	0.709	0.272

B-6

PROCUREMENT OF MISSILES
OTHER OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	18206	0	0	5069	10511	0.118	0.205
2	.	.	.	31363	36608	0	22657	19796	0.358	0.319
3	.	.	.	34426	46592	0	27006	24166	0.419	0.366
4	.	.	.	34720	47701	58	27493	24630	0.426	0.370
5	.	.	.	37462	49295	1349	29369	24977	0.463	0.373
6	.	.	.	38194	52510	12141	34282	20467	0.582	0.214
7	.	.	34711	40353	57738	24348	39288	13972	0.688	0.098
8	.	.	68851	41571	58210	25265	48474	19116	0.839	0.183
9	.	.	39295	43331	59235	25712	41891	13801	0.735	0.089
10	.	.	42395	43729	59860	26802	43197	13508	0.759	0.071
11	.	.	42476	46604	62964	29381	45431	13826	0.802	0.092
12	.	.	54844	48992	71534	32065	51659	16289	0.908	0.033
13	.	.	48777	48997	71600	.	55458	13114	0.880	0.089
14	.	.	50656	14567	72435	.	45886	29227	0.669	0.337
15	.	.	51311	34203	72503	.	52672	19186	0.801	0.124
16	.	.	51143	36196	72561	.	53300	18278	0.813	0.101
17	.	.	51330	39092	72591	.	54338	16951	0.833	0.075
18	.	.	51533	40657	72615	.	54868	16270	0.844	0.062
19	.	65093	51734	49846	72863	.	60134	11165	0.907	0.072
20	.	133300	52676	49923	73426	.	77381	38717	0.916	0.063
21	.	67500	53143	49244	73477	.	60841	11515	0.913	0.055
22	.	67422	53476	49250	73018	.	60792	11257	0.913	0.052
23	.	67183	53258	49350	73239	.	60633	11240	0.915	0.052
24	.	67680	54044	51117	73531	.	61592	10745	0.930	0.065
25	.	67652	53483	50741	.	.	57459	8975	0.929	0.088
26	.	67931	40899	50550	.	.	53123	13703	0.822	0.234
27	.	67609	47436	50487	.	.	55244	10988	0.874	0.159
28	.	63059	47494	48630	.	.	54728	11559	0.856	0.132
29	.	68141	47546	50013	.	.	55240	11258	0.870	0.151
30	.	68195	48405	48886	.	.	55162	11289	0.866	0.126
31	51548	68199	53950	48467	.	.	55516	8738	0.905	0.058
32	103089	68588	53411	48467	.	.	69389	24667	0.902	0.063
33	51555	68527	53520	47753	.	.	55339	9112	0.896	0.052
34	51555	68751	54496	48382	.	.	55794	8991	0.910	0.050
35	51576	68735	53873	48637	.	.	55705	8947	0.907	0.060
36	51581	68737	54712	49127	.	.	56054	8797	0.919	0.057

PROCUREMENT OF MISSILES
TOTAL(F4S+MAP+OTHER) OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	18206	16694	394	11765	9876	0.035	0.033
2	.	.	.	46240	123362	14770	61457	55872	0.156	0.109
3	.	.	.	71716	167377	54412	97835	60843	0.253	0.102
4	.	.	.	79310	184075	58548	107311	67285	0.277	0.115
5	.	.	.	94187	217778	72147	128048	78483	0.331	0.132
6	.	.	.	100180	291879	93975	162011	112511	0.409	0.181
7	.	.	198479	112846	308436	118749	184628	91311	0.418	0.158
8	.	.	404576	133151	334284	154539	256637	133650	0.551	0.124
9	.	.	244637	154710	352008	218566	243481	80801	0.566	0.151
10	.	.	303814	144672	377727	224630	268961	91046	0.616	0.136
11	.	.	313852	142082	396382	259680	288127	90452	0.665	0.146
12	.	.	460090	225265	436348	330439	369536	116034	0.836	0.078
13	.	.	400184	236725	440954	.	359954	113757	0.786	0.166
14	.	.	419005	231617	444372	.	364998	116206	0.804	0.157
15	.	.	445958	239659	444615	.	367744	118721	0.827	0.140
16	.	.	456135	242203	447427	.	381922	121078	0.838	0.136
17	.	.	455242	246805	449932	.	384010	118853	0.845	0.142
18	.	.	453955	247136	453422	.	384838	119253	0.847	0.146
19	.	746640	460052	248547	460373	.	478903	204488	0.856	0.147
20	.	1497154	452983	248514	462071	.	665331	563640	0.854	0.154
21	.	760244	455392	249065	459638	.	481085	210462	0.854	0.151
22	.	762957	458331	249334	458814	.	484484	211458	0.856	0.148
23	.	764108	464072	250342	459979	.	484627	211368	0.860	0.145
24	.	789251	471536	252464	462115	.	493842	221385	0.868	0.142
25	.	791007	471111	251991	.	.	504704	271073	0.822	0.166
26	.	802394	469197	251821	.	.	507805	277312	0.820	0.168
27	.	807699	470804	252297	.	.	510268	279796	0.822	0.167
28	.	809295	470761	248598	.	.	509551	282364	0.815	0.158
29	.	811429	470402	251449	.	.	511093	282199	0.820	0.166
30	.	813458	470777	251350	.	.	511862	283297	0.820	0.165
31	329180	816913	622717	251924	.	.	467411	250551	0.821	0.165
32	658983	823287	487070	252520	.	.	550890	246071	0.821	0.170
33	331177	824573	469480	252445	.	.	469420	253195	0.821	0.169
34	331229	821431	471011	251994	.	.	470342	254726	0.821	0.166
35	333801	830722	470277	252486	.	.	471822	255584	0.822	0.168
36	336084	830936	471119	252174	.	.	472578	255363	0.822	0.167

PROCUREMENT OF MISSILES, ORDERS IN THOUSANDS, CUMULATIVE
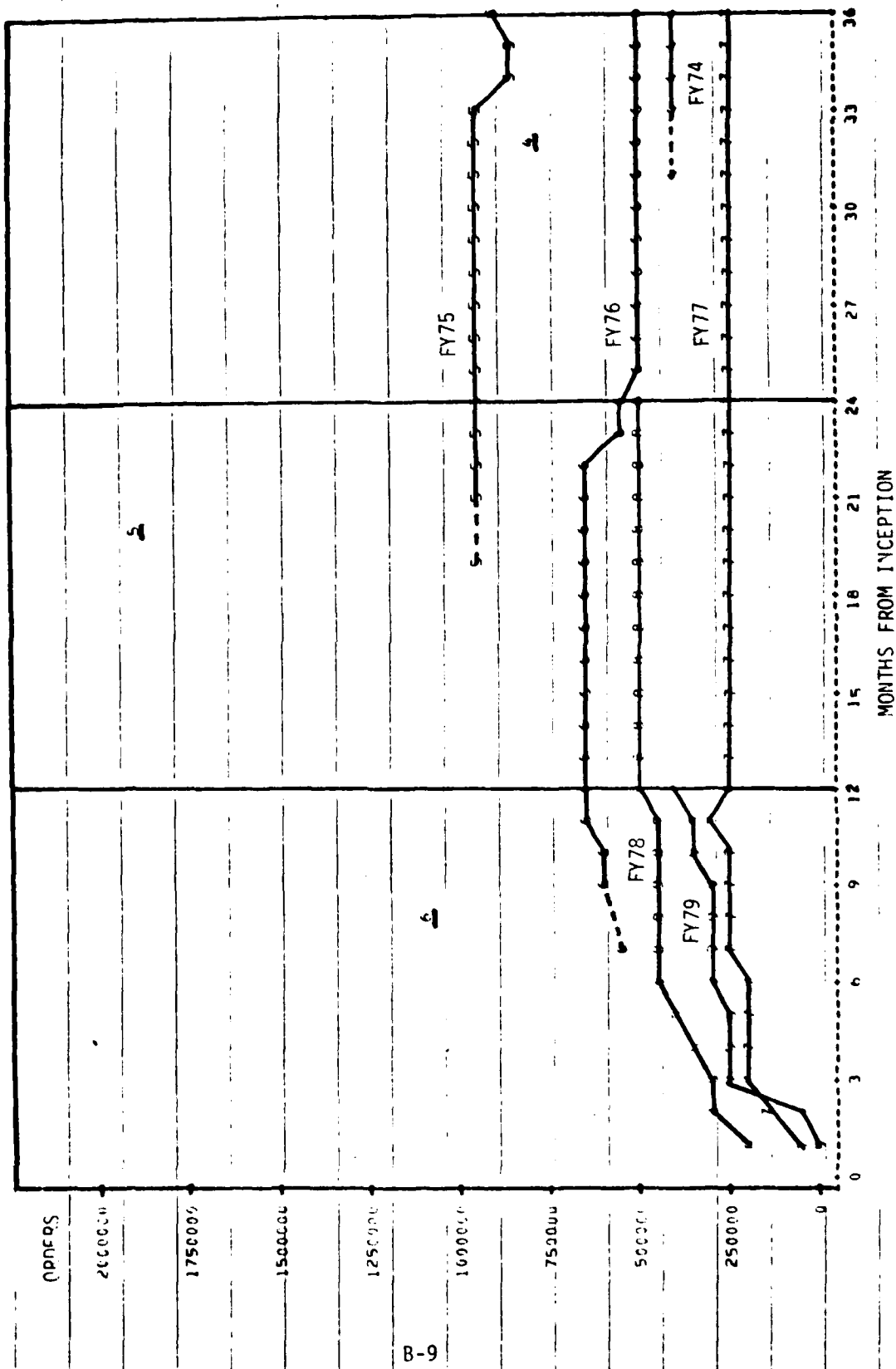
PROCUREMENT OF MISSILES, ORDER FACTORS

FY77

FY76

FY78

FY79

FACTO

1.6

1.4

1.2

1.0

0.8

0.6

0.4

0.2

0.0

MONTHS FROM INCEPTION

0   3   6   9   12   15   18   21   24   27   30   33   36

B-10

PROCUREMENT OF MISSILES, OBLIGATIONS IN THOUSANDS, CUMULATIVE

OBLIGATIONS

MONTHS FROM INCEPTION
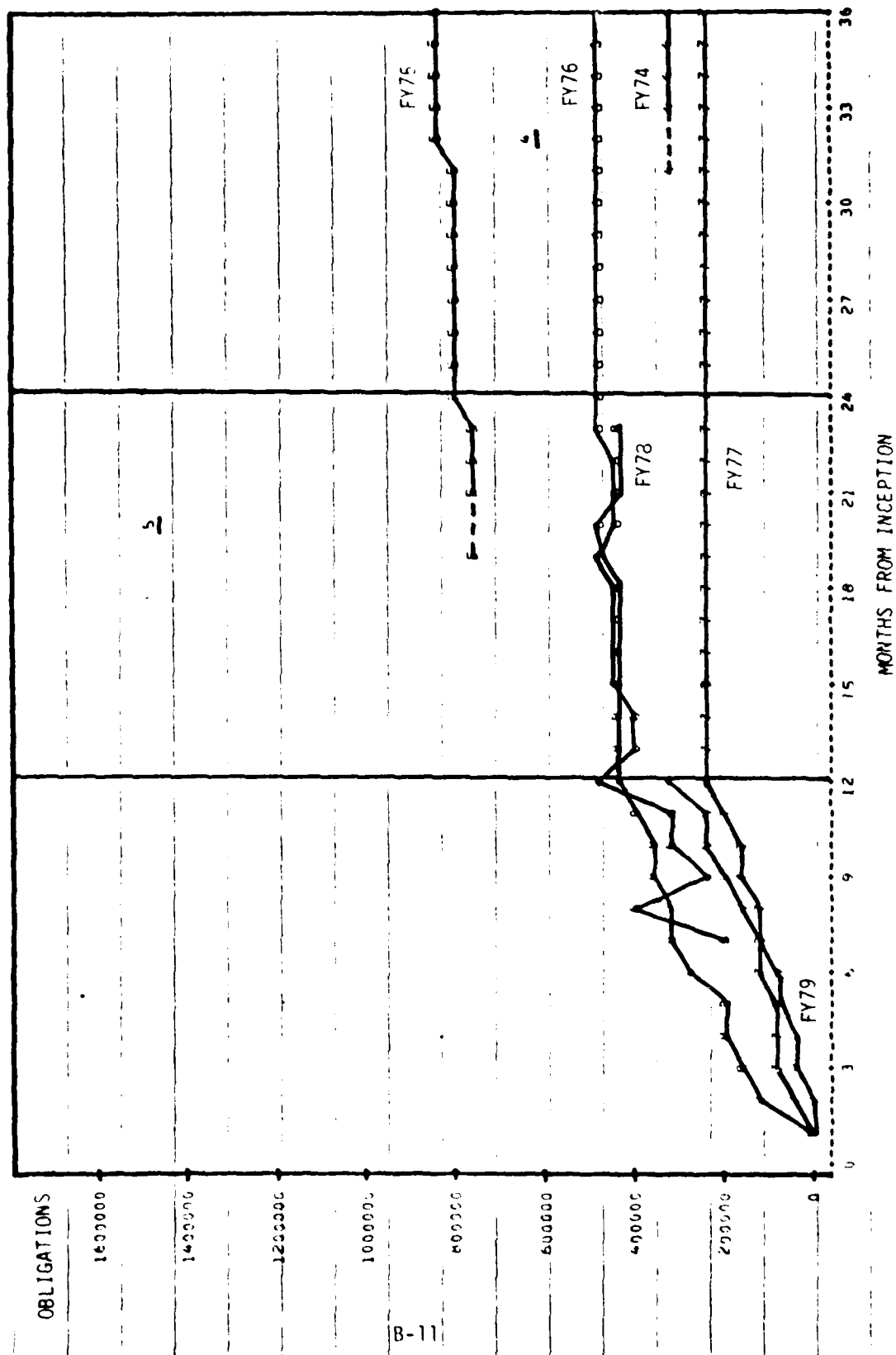
PROCUREMENT OF MISSILES, OBLIGATION FACTORS

MONTHS FROM INCEPTION
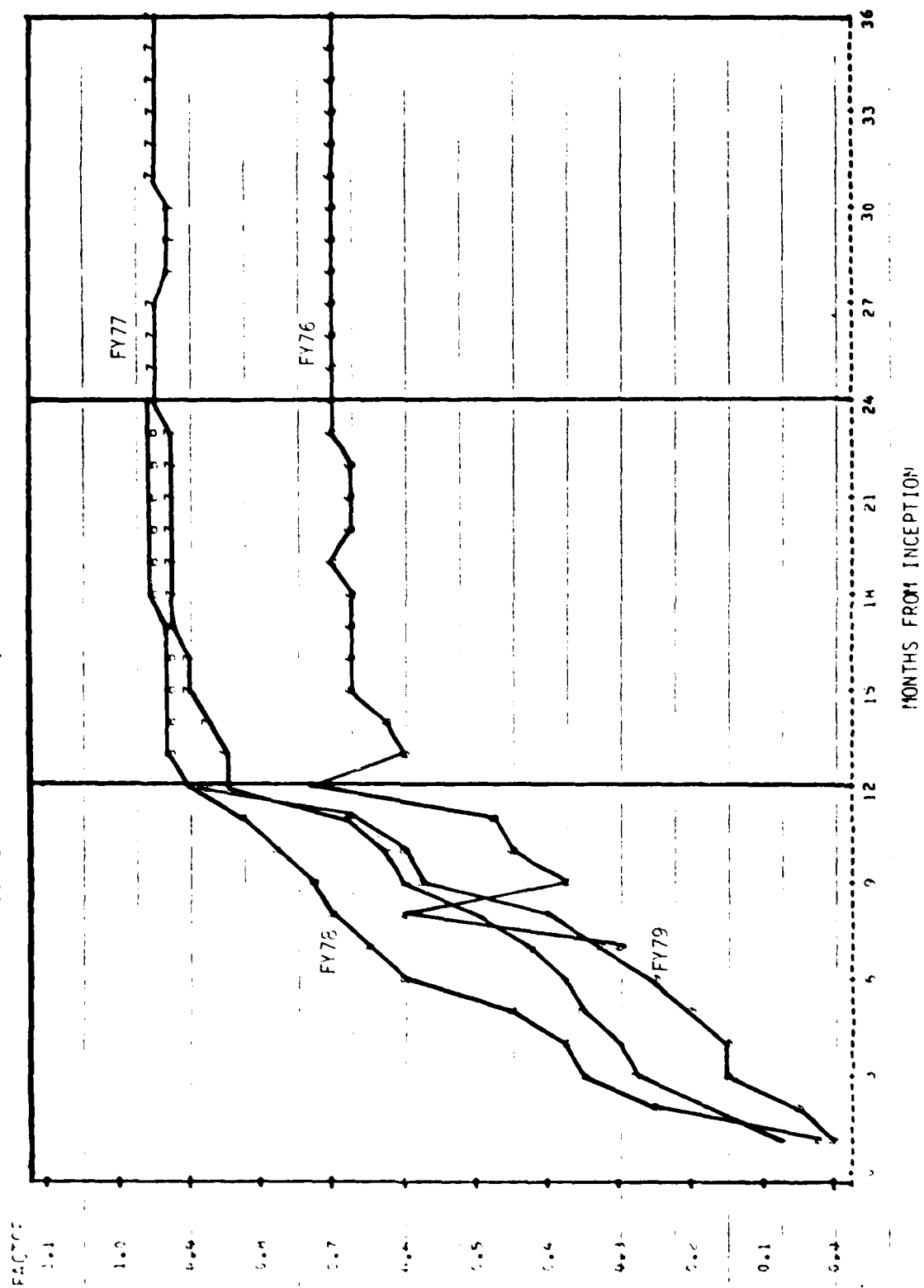
PROCUREMENT OF WEAPONS & IC VEHICLES
FOREIGN MILITARY SALES ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	•	•	•	6095	142403	1212	49903	80144	0.172	0.277
2	•	•	•	24594	205085	31529	87069	102263	0.293	0.360
3	•	•	•	85233	189422	101967	125541	55952	0.407	0.214
4	•	•	•	84497	281157	128242	164632	103257	0.535	0.378
5	•	•	•	108278	277748	132548	172858	91644	0.563	0.344
6	•	•	•	177942	232016	204717	204905	27017	0.655	0.131
7	•	•	212745	209125	256075	225930	225731	20850	0.617	0.263
8	•	•	415432	214515	250747	229513	281177	91450	0.695	0.168
9	•	•	500461	210509	249068	245328	327842	161986	0.761	0.072
10	•	•	541128	205271	253839	291520	332940	169184	0.770	0.079
11	•	•	566748	311670	254612	343601	395168	184442	0.927	0.107
12	•	•	715411	230467	269525	372396	442075	252233	1.000	0.000
13	•	•	334137	272922	291017	•	299359	31448	0.785	0.327
14	•	•	759354	272994	291995	•	444744	281255	0.964	0.039
15	•	•	758447	272927	291976	•	444453	280757	0.963	0.039
16	•	•	417702	272550	291563	•	460605	309401	0.983	0.038
17	•	•	722447	273219	291607	•	462558	312155	0.985	0.039
18	•	•	521515	272645	272374	•	462179	311348	0.985	0.040
19	•	234475	521734	272608	293780	•	458840	278514	0.987	0.042
20	•	355547	505003	272288	295196	•	432259	251029	0.981	0.041
21	•	262453	776340	272367	295051	•	401553	250230	0.969	0.044
22	•	261653	770013	272371	235853	•	401325	250212	0.970	0.045
23	•	263194	755978	274756	295691	•	398406	238108	0.970	0.050
24	•	262722	558145	280525	266729	•	372095	191003	0.921	0.100
25	•	157605	527740	267599	•	•	351061	245854	0.845	0.107
26	•	331279	548326	267585	•	•	415752	203974	0.858	0.089
27	•	333107	527549	268228	•	•	409641	191516	0.846	0.109
28	•	335003	538422	268576	•	•	414399	197242	0.854	0.100
29	•	334015	538730	269437	•	•	414327	197069	0.855	0.102
30	•	334030	533922	269621	•	•	412791	194261	0.853	0.107
31	963217	344643	535781	269627	•	•	550367	317631	0.853	0.107
32	1128924	321465	533615	269638	•	•	588411	394577	0.852	0.107
33	946632	312583	531480	269801	•	•	540874	314688	0.851	0.110
34	945532	312351	530609	268876	•	•	540092	314453	0.849	0.108
35	470393	304934	525808	268945	•	•	544771	328481	0.846	0.112
36	476377	302477	595175	261565	•	•	533824	330355	0.815	0.121

PROCUREMENT OF WEAPONS & TC VEHICLES
MILITARY ASSISTANCE PROGRAM ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	469	250	52	257	209	0.011	0.008
2	.	.	.	309	6274	10	2198	3533	0.144	0.241
3	.	.	.	874	1734	89	899	823	0.049	0.059
4	.	.	.	1351	3774	1267	2131	1424	0.118	0.118
5	.	.	.	2865	7406	1494	3922	3094	0.219	0.242
6	.	.	3249	6652	7328	3742	7574	1066	0.369	0.146
7	.	.	6540	9569	7500	12842	8365	3999	0.390	0.209
8	.	.	26612	16026	7958	13297	10960	4453	0.484	0.142
9	.	.	20676	15638	10655	14786	16923	6816	0.761	0.282
10	.	.	21426	15633	11763	17509	16395	3724	0.747	0.179
11	.	.	23636	29588	16086	18133	21308	5942	0.944	0.101
12	.	.	19611	32069	14857	21561	22881	7084	1.000	0.000
13	.	.	22595	32070	13457	.	21713	9483	0.919	0.075
14	.	.	22945	27858	14856	.	21770	6540	0.950	0.071
15	.	.	21969	29279	14856	.	22360	7229	0.970	0.049
16	.	.	21755	27859	14657	.	21495	6614	0.936	0.061
17	.	.	12787	32071	14579	.	22802	8793	0.975	0.028
18	.	90111	21813	32079	14596	.	19821	10654	0.846	0.252
19	.	172364	23228	32079	14585	.	39797	34693	0.976	0.027
20	.	83950	23077	32083	14585	.	60610	74964	0.997	0.014
21	.	90077	23117	32081	11647	.	39190	34861	0.929	0.125
22	.	90437	22494	32085	14740	.	40005	34125	0.999	0.006
23	.	91005	22426	32085	14745	.	40055	34648	0.990	0.012
24	.	14711	22425	32074	15093	.	40150	34609	0.997	0.021
25	.	23713	22437	32050	.	.	23062	8687	0.986	0.018
26	.	25013	22544	32050	.	.	25932	5316	0.987	0.018
27	.	23513	22556	32050	.	.	25976	5274	0.989	0.014
28	.	23515	22558	32056	.	.	25976	5279	0.989	0.014
29	.	23674	22543	32065	.	.	25974	5286	0.990	0.014
30	.	23673	22583	32065	.	.	25972	5288	0.990	0.014
31	11146	22663	22595	32067	.	.	22270	8578	0.990	0.013
32	17648	22648	22574	32067	.	.	23609	6063	0.990	0.014
33	10247	21698	22575	32067	.	.	21647	8933	0.990	0.014
34	10236	21632	22575	32040	.	.	21671	8928	0.990	0.014
35	11204	21204	22441	32058	.	.	21888	8524	0.987	0.018
36	11215	21158	22203	26416	.	.	20456	6489	0.894	0.099

PROCUREMENT OF WEAPONS & TC VEHICLES
OTHER ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	·	·	·	21358	57681	36	26358	29146	0.489	0.426
2				25411	72319	43956	47229	23625	0.864	0.104
3				28560	60279	44279	44373	15860	0.845	0.057
4				28638	67621	44746	47018	19586	0.882	0.059
5				29063	67856	47507	48142	19404	0.904	0.036
6				30843	65818	52643	49768	17664	0.945	0.045
7			110791	31495	67700	54436	66103	33329	1.004	0.076
8			108025	31115	68148	55278	65642	32157	1.000	0.062
9			114264	31356	68155	55530	68576	37081	1.031	0.112
10			119329	31381	71072	56007	69447	37061	1.043	0.100
11			98804	31537	72022	57160	64881	28126	1.002	0.026
12			100332	31377	73553	55080	65086	29157	1.000	0.000
13			9467	31382	73563		38134	32572	0.698	0.523
14			96695	31174	73563		67144	33229	0.986	0.019
15			96702	31269	73563		67178	33180	0.987	0.020
16			97747	31252	76589		68529	33972	1.004	0.034
17			97748	31186	73450		67461	33683	0.989	0.013
18			110231	31173	73444		71616	39561	1.030	0.059
19		110696	97778	31086	73448		78152	34908	0.988	0.012
20		81070	97805	31074	73465		70854	28402	0.988	0.012
21		75416	97813	30898	76335		70466	28215	0.999	0.034
22		78016	97689	30898	73461		70016	28118	0.986	0.043
23		77594	107239	30740	73461		72259	31503	1.016	0.047
24		77607	97693	31174	72601		69766	27918	0.985	0.010
25		56236	97683	31174			44918	47412	0.984	0.014
26		77000	97619	31175			68598	34010	0.983	0.014
27		77001	97657	51174			75277	23289	1.302	0.465
28		76499	97036	31173			68403	33762	0.980	0.019
29		75731	97035	31172			68313	33729	0.980	0.019
30		76722	96737	30997			68155	33699	0.976	0.017
31	59865	76735	96718	30997			66079	27619	0.976	0.017
32	53429	75231	98782	30999			64610	29070	0.986	0.002
33	75292	75231	96335	30981			69460	27509	0.974	0.019
34	76272	75231	96316	30778			69649	27671	0.970	0.015
35	47234	75231	65728	30740			54741	19761	0.818	0.230
36	47234	75212	96706	30255			62352	29464	0.964	0.000

PROCUREMENT OF WEAPONS & TC VEHICLES
TOTAL(FMS+MAP+OTHER) ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	•	•	•	27922	200334	1300	76519	108050	0.204	0.285
2	•	•	•	50314	283678	75495	136496	128084	0.354	0.344
3	•	•	•	146667	251435	146335	170812	71594	0.438	0.197
4	•	•	•	114486	352552	174305	213781	123845	0.548	0.335
5	•	•	•	140206	353010	181549	224922	112837	0.578	0.308
6	•	•	•	215477	305162	265102	262247	44967	0.670	0.120
7	•	•	326625	250189	330575	296208	309949	37177	0.647	0.220
8	•	•	550517	266657	335853	298088	357779	118582	0.718	0.138
9	•	•	711337	257503	327878	355644	413091	203076	0.786	0.060
10	•	•	721133	252285	336674	365036	418782	207178	0.796	0.075
11	•	•	747018	372795	346720	418894	481357	205947	0.935	0.089
12	•	•	739279	353913	377935	449037	530041	275799	1.000	0.000
13	•	•	363218	336374	378027	•	359206	21114	0.779	0.341
14	•	•	448684	332026	380414	•	533708	308369	0.964	0.037
15	•	•	548164	333475	340395	•	533991	307567	0.965	0.036
16	•	•	937418	331661	382809	•	550629	335944	0.983	0.040
17	•	•	742350	336475	379636	•	552821	338032	0.986	0.031
18	•	•	944534	335901	380416	•	553616	339273	0.987	0.033
19	•	435764	941585	335773	362013	•	523789	281513	0.987	0.034
20	•	610161	926036	355445	383246	•	563722	269636	0.983	0.033
21	•	429223	837236	335346	383033	•	511208	260186	0.972	0.036
22	•	429156	396819	335354	384054	•	511346	259821	0.973	0.038
23	•	431729	504711	341581	384897	•	510730	252024	0.975	0.039
24	•	431734	778308	343766	374423	•	482008	200854	0.930	0.089
25	•	178410	747898	330823	•		419040	294810	0.865	0.098
26	•	431049	758442	330810	•		510282	229186	0.876	0.082
27	•	433421	747310	331452	•		504228	217022	0.866	0.099
28	•	435115	758416	331801	•		508777	222396	0.872	0.092
29	•	434819	758348	332674	•		508614	222225	0.874	0.094
30	•	434831	753242	332683	•		506919	219351	0.871	0.098
31	1034231	434847	753094	332691	•		638716	318710	0.871	0.098
32	1200001	418447	752971	332704	•		676131	393481	0.871	0.098
33	1032171	412512	750393	332849	•		631981	322397	0.870	0.100
34	1032046	412414	749500	331694	•		631412	322614	0.868	0.098
35	1033836	406003	743277	331783	•		628900	324128	0.865	0.103
36	1034836	344377	714084	318236	•		616633	326921	0.830	0.098

PROCUREMENT OF WEAPONS & TC VEHICLES
FOREIGN MILITARY SALES OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	4	894	299	515	0.001	0.001
2	.	.	.	2724	9244	1236	4401	4259	0.015	0.015
3	.	.	.	16072	2007	2937	7005	7866	0.023	0.028
4	.	.	.	17903	11839	5508	11750	6198	0.039	0.023
5	.	.	.	22927	15087	28502	22172	6739	0.069	0.015
6	.	.	.	46997	77781	98651	74476	25985	0.232	0.061
7	.	.	52719	50876	89194	102150	73735	25888	0.206	0.110
8	.	.	123406	55273	112760	166990	99607	30328	0.255	0.107
9	.	.	252442	60659	114367	132717	150546	99499	0.331	0.084
10	.	.	300971	78394	124612	140160	161034	96909	0.361	0.067
11	.	.	310396	150319	132363	154660	187935	82375	0.445	0.058
12	.	.	446188	226217	242162	300523	303773	100172	0.742	0.132
13	.	.	164901	225505	242640	.	211015	40845	0.606	0.351
14	.	.	462534	229245	243185	.	311656	130853	0.732	0.145
15	.	.	507178	228564	245835	.	327192	156111	0.753	0.118
16	.	.	473890	224113	246954	.	316652	136464	0.741	0.142
17	.	.	513572	232400	247934	.	331302	158041	0.762	0.118
18	.	.	516164	232921	251380	.	333488	158471	0.768	0.122
19	.	186933	520229	240600	250802	.	299816	150047	0.778	0.122
20	.	323195	525617	240415	251827	.	335264	132083	0.781	0.120
21	.	214010	528899	239080	254543	.	309358	147276	0.784	0.121
22	.	212741	529908	239499	255542	.	309423	148047	0.786	0.121
23	.	200606	553723	241258	254869	.	312969	162286	0.799	0.108
24	.	208532	554325	247783	255327	.	318957	164868	0.809	0.103
25	.	118127	660640	247940	.	.	309036	227495	0.770	0.118
26	.	213436	649926	247730	.	.	337031	185168	0.763	0.126
27	.	213895	660847	247992	.	.	342911	194682	0.774	0.112
28	.	214299	560059	248466	.	.	340941	190529	0.771	0.119
29	.	214895	560731	246272	.	.	340633	191255	0.768	0.114
30	.	214447	553317	246151	.	.	341438	192789	0.769	0.111
31	816529	213053	502884	246463	.	.	445985	278267	0.732	0.164
32	853368	214351	562720	246488	.	.	469232	300488	0.769	0.112
33	851458	217576	562450	246717	.	.	469550	298680	0.769	0.113
34	834564	217915	560612	246386	.	.	464869	291297	0.768	0.114
35	834759	225661	561236	244295	.	.	466505	289820	0.764	0.108
36	834152	226009	553320	247012	.	.	468873	291108	0.770	0.113

PROCUREMENT OF WEAPONS & TC VEHICLES
MILITARY ASSISTANCE PROGRAM OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	0	0	0	0	0	0.000	0.000
3	.	.	.	0	286	0	95	165	0.006	0.011
4	.	.	.	0	290	0	97	162	0.007	0.011
5	.	.	292	292	290	4179	194	168	0.010	0.010
6	.	.	1510	1845	869	4652	2298	1701	0.103	0.078
7	.	.	3021	1887	962	5169	2253	1644	0.101	0.076
8	.	.	6946	5654	1259	10014	3771	2026	0.158	0.066
9	.	.	9057	5654	4186	10651	7200	2735	0.328	0.126
10	.	.	10456	6811	4728	10799	7815	2592	0.355	0.119
11	.	.	12396	4829	5450	16299	9134	2488	0.407	0.087
12	.	.	13039	21610	8662	.	14739	5541	0.638	0.097
13	.	.	13141	21612	8281	.	14311	6756	0.599	0.065
14	.	.	13479	20560	8691	.	14144	5993	0.599	0.037
15	.	.	13356	21691	8708	.	14626	6567	0.616	0.052
16	.	.	14272	21617	8749	.	14576	6519	0.614	0.052
17	.	.	14434	21625	8811	.	14905	6430	0.629	0.041
18	.	.	.	22652	9092	.	15393	6831	0.648	0.051
19	.	8022	14634	23298	9150	.	13476	7321	0.659	0.059
20	.	10396	15616	23325	9295	.	14656	6405	0.677	0.051
21	.	14424	15532	23165	10677	.	15950	5240	0.705	0.027
22	.	14445	15561	23203	10915	.	16031	5175	0.711	0.031
23	.	14551	16105	23221	10997	.	15219	5135	0.721	0.021
24	.	15450	16741	23540	11681	.	16853	4948	0.749	0.032
25	.	7442	16199	23474	.	.	16372	7018	0.718	0.020
26	.	14272	17277	23509	.	.	14353	4712	0.742	0.012
27	.	14510	17304	27707	.	.	17774	7032	0.808	0.080
28	.	14240	16791	23583	.	.	18205	4829	0.732	0.005
29	.	14238	16776	23315	.	.	18137	4655	0.728	0.002
30	.	14664	18914	22925	.	.	18834	4131	0.768	0.075
31	4010	14715	17026	22992	.	.	14687	7926	0.728	0.016
32	6558	14739	17028	22997	.	.	15331	6806	0.728	0.016
33	3947	14814	17030	23120	.	.	14728	7999	0.730	0.013
34	3866	14858	17174	23054	.	.	14741	8027	0.732	0.019
35	3953	15145	17196	23141	.	.	14856	8021	0.734	0.017
36	3924	15411	17195	23625	.	.	15041	8205	0.742	0.007

PROCUREMENT OF WEAPONS & TC VEHICLES
OTHER OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	10660	29100	0	13253	14722	0.245	0.214
2	.	.	.	10660	32470	464	14531	16350	0.263	0.226
3	.	.	.	14730	41436	17303	24490	14732	0.449	0.126
4	.	.	.	15779	44607	24751	28379	14752	0.520	0.080
5	.	.	.	16987	46570	30955	31604	14952	0.580	0.050
6	.	.	.	21730	51889	31733	35117	15362	0.658	0.071
7	.	.	83297	22089	52585	32191	47541	27002	0.708	0.100
8	.	.	93189	23654	52733	32439	50604	30876	0.749	0.138
9	.	.	95490	27284	54840	40224	54460	29579	0.824	0.105
10	.	.	97130	27693	58431	41254	56128	30089	0.849	0.097
11	.	.	97773	30676	65537	45440	59857	29036	0.917	0.073
12	.	.	102349	35899	75248	53715	66803	28643	1.041	0.072
13	.	.	4511	35900	75413	.	38608	35528	0.738	0.603
14	.	.	100963	35532	75623	.	70699	32982	1.056	0.067
15	.	.	104110	35264	75401	.	71792	34266	1.069	0.065
16	.	.	102989	35847	75389	.	71408	33748	1.065	0.067
17	.	.	103042	35028	75457	.	71732	33926	1.070	0.070
18	.	.	103977	36543	76601	.	72387	33894	1.081	0.073
19	.	114765	104137	35728	82440	.	84269	35046	1.099	0.054
20	.	94775	104722	36510	82878	.	79721	30160	1.111	0.061
21	.	93622	105335	36304	83036	.	79576	30251	1.112	0.056
22	.	92329	105302	36552	83332	.	79379	29942	1.146	0.060
23	.	112098	105501	34981	80232	.	83703	34042	1.107	0.065
24	.	93043	107936	36496	85656	.	80813	30847	1.136	0.052
25	.	4041	107061	36624	.	.	49455	52969	1.120	0.067
26	.	94416	120203	36664	.	.	83788	42811	1.184	0.022
27	.	94417	102238	35764	.	.	77473	36332	1.079	0.085
28	.	94434	107987	36650	.	.	79690	37885	1.122	0.065
29	.	94496	103908	38510	.	.	80338	36849	1.152	0.107
30	.	94158	104536	38465	.	.	79056	35533	1.134	0.130
31	96812	94289	107933	38538	.	.	84393	31139	1.152	0.108
32	87379	94305	107832	35633	.	.	81287	31599	1.105	0.043
33	85829	94425	108547	38664	.	.	81366	30215	1.157	0.106
34	81757	94522	107000	38661	.	.	80487	30727	1.149	0.117
35	81764	94410	106510	38711	.	.	80349	29540	1.148	0.122
36	81723	95167	107015	39657	.	.	80886	29363	1.165	0.139

PROCUREMENT OF WEAPONS & TC VEHICLES
TOTAL(FMS+MAP+OTHER) OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	10660	29104	894	13553	14326	0.036	0.038
2	.	.	.	13384	41717	1700	18934	20578	0.051	0.054
3	.	.	.	30802	43729	20240	31590	11764	0.083	0.036
4	.	.	.	33682	56736	30259	40226	14400	0.104	0.042
5	.	.	.	40206	62247	59457	53970	12001	0.137	0.026
6	.	.	.	70572	130539	134563	111891	35840	0.281	0.075
7	.	.	137526	74852	142741	138993	123528	32525	0.261	0.103
8	.	.	219610	84581	164752	144978	153982	55882	0.309	0.097
9	.	.	396678	93597	175393	182955	212206	129593	0.390	0.087
10	.	.	407168	112698	187771	192069	224927	126843	0.419	0.074
11	.	.	418625	190827	203350	214899	256925	108247	0.500	0.046
12	.	.	560723	283726	326072	370537	385315	122320	0.772	0.119
13	.	182452	283017	326334	.	.	263934	73815	0.619	0.369
14	.	576662	285337	327499	.	.	396499	157443	0.762	0.132
15	.	524757	286119	329945	.	.	413610	184175	0.782	0.106
16	.	590241	286577	331092	.	.	402637	163988	0.771	0.128
17	.	531493	290123	332202	.	.	417939	186136	0.790	0.106
18	.	533575	292156	337673	.	.	420935	185516	0.797	0.111
19	368022	539700	299626	342392	.	.	397561	162474	0.811	0.117
20	428366	545955	300250	343990	.	.	429640	153700	0.815	0.115
21	322863	549766	298549	343356	.	.	404884	164517	0.819	0.117
22	319513	550771	299254	349789	.	.	404832	165269	0.821	0.118
23	326056	575329	301460	348118	.	.	412891	175995	0.831	0.103
24	315705	599004	308019	352564	.	.	416623	182605	0.846	0.102
25	131850	564700	308038	.	.	.	374863	282418	0.800	0.100
26	322124	587496	307903	.	.	.	439171	215165	0.801	0.098
27	322622	586389	305163	.	.	.	438058	215238	0.797	0.093
28	322973	584837	305699	.	.	.	437836	214083	0.796	0.095
29	323484	565537	308097	.	.	.	439108	213556	0.800	0.099
30	323049	544757	307541	.	.	.	438652	213294	0.799	0.099
31	917351	327070	587845	307993	.	.	560065	295414	0.801	0.098
32	947305	323395	587580	308118	.	.	566600	308509	0.801	0.098
33	937234	326815	588045	308501	.	.	565149	303437	0.802	0.098
34	920187	327312	584786	308101	.	.	560097	296031	0.800	0.100
35	920486	335216	584992	306147	.	.	561710	294692	0.797	0.096
36	924804	336567	587533	310294	.	.	564800	295257	0.804	0.102

PROCUREMENT OF WEAPONS AND TC VEH., ORDERS IN THOUSANDS, CUMULATIVE

ORDERS

1400000
1300000
1200000
1100000
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0

MONTHS FROM INCEPTION

FY74
FY75
FY76
FY77
FY78
FY79

C-9
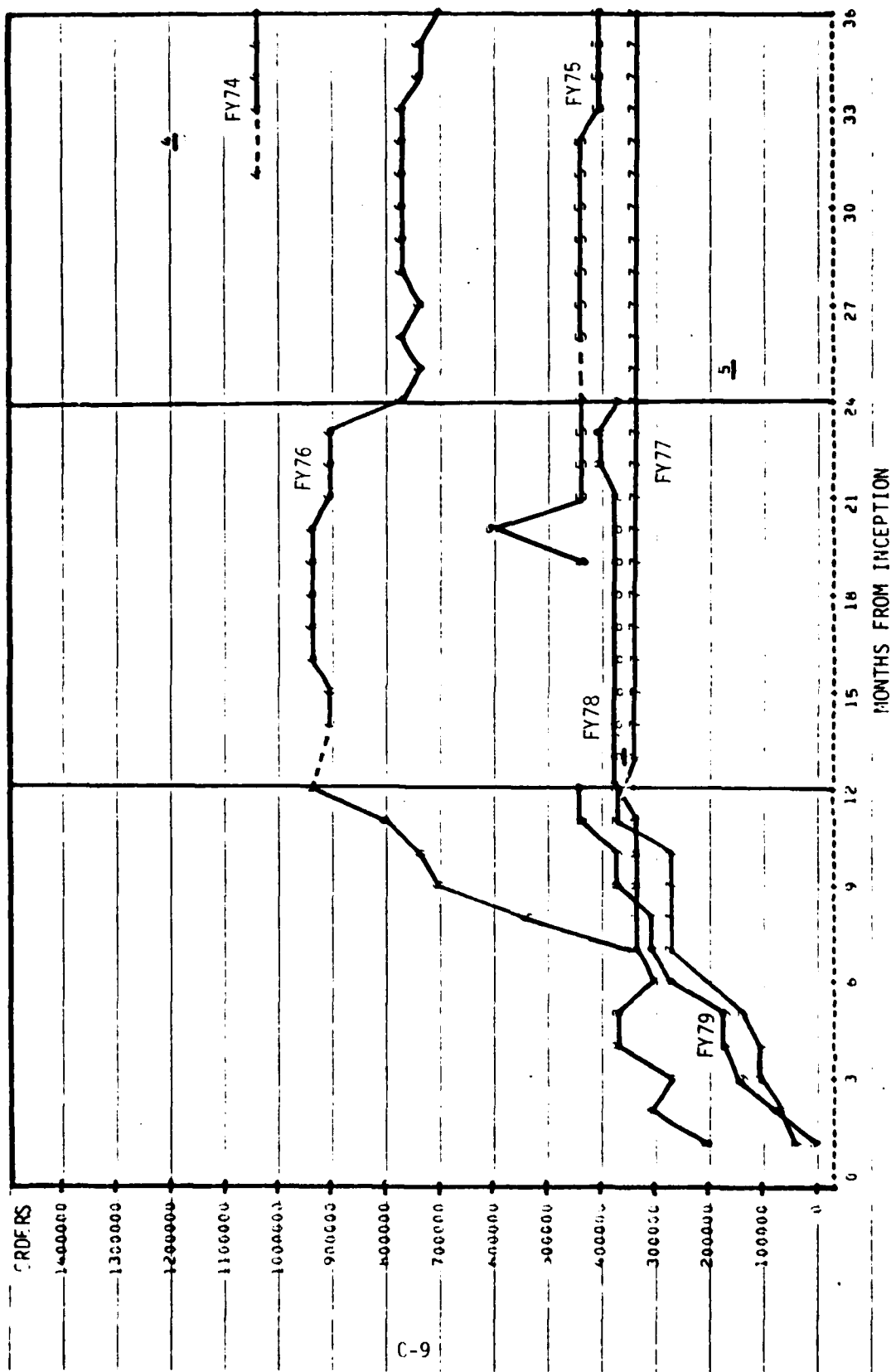
PROCUREMENT OF WEAPONS AND TC VEH., ORDER FACTORS
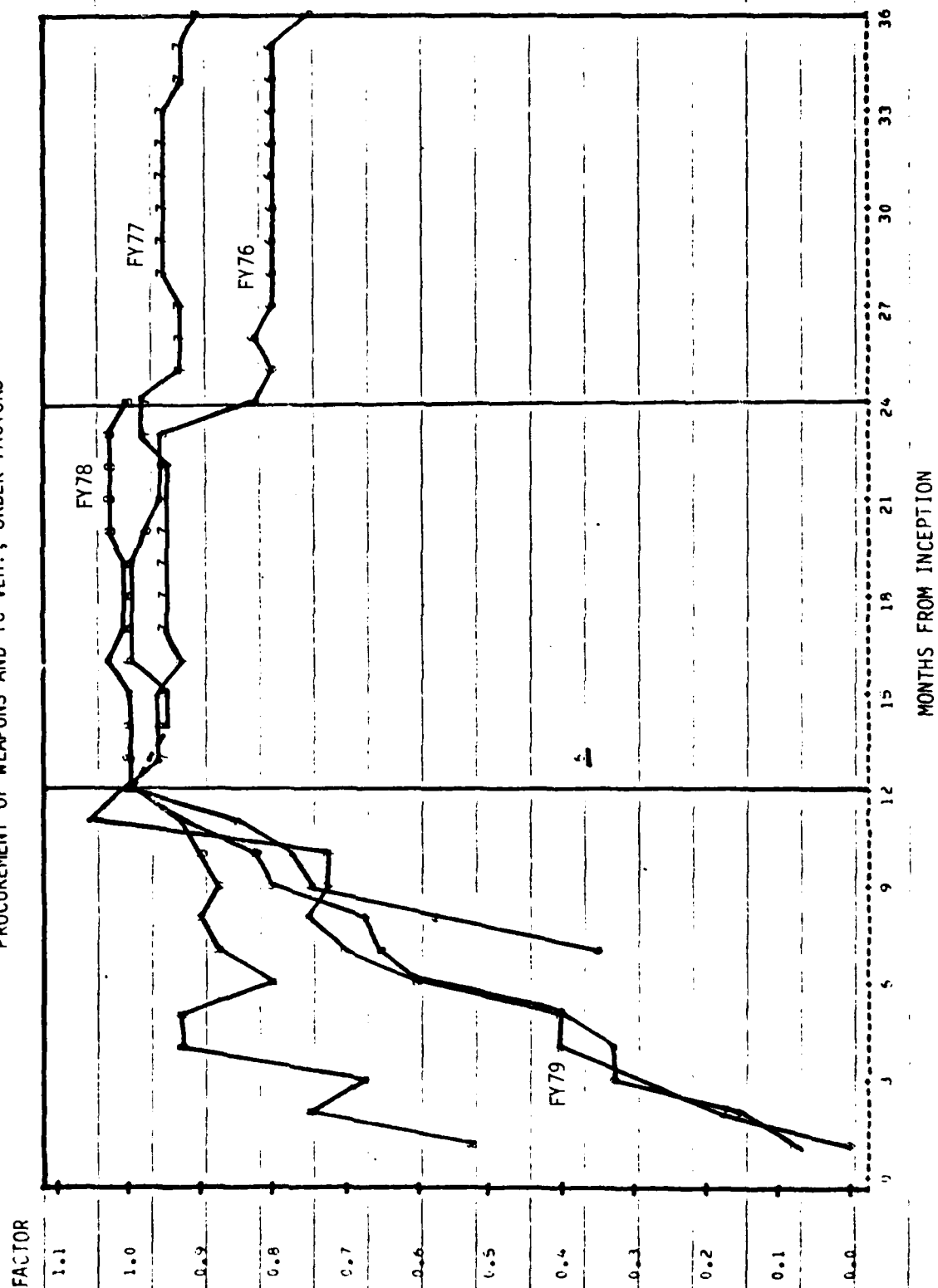
C-10

PROCUREMENT OF WEAPONS AND TC VEH., OBLIGATIONS IN THOUSANDS, CUMULATIVE

OBLIGATIONS

MONTHS FROM INCEPTION

C-11
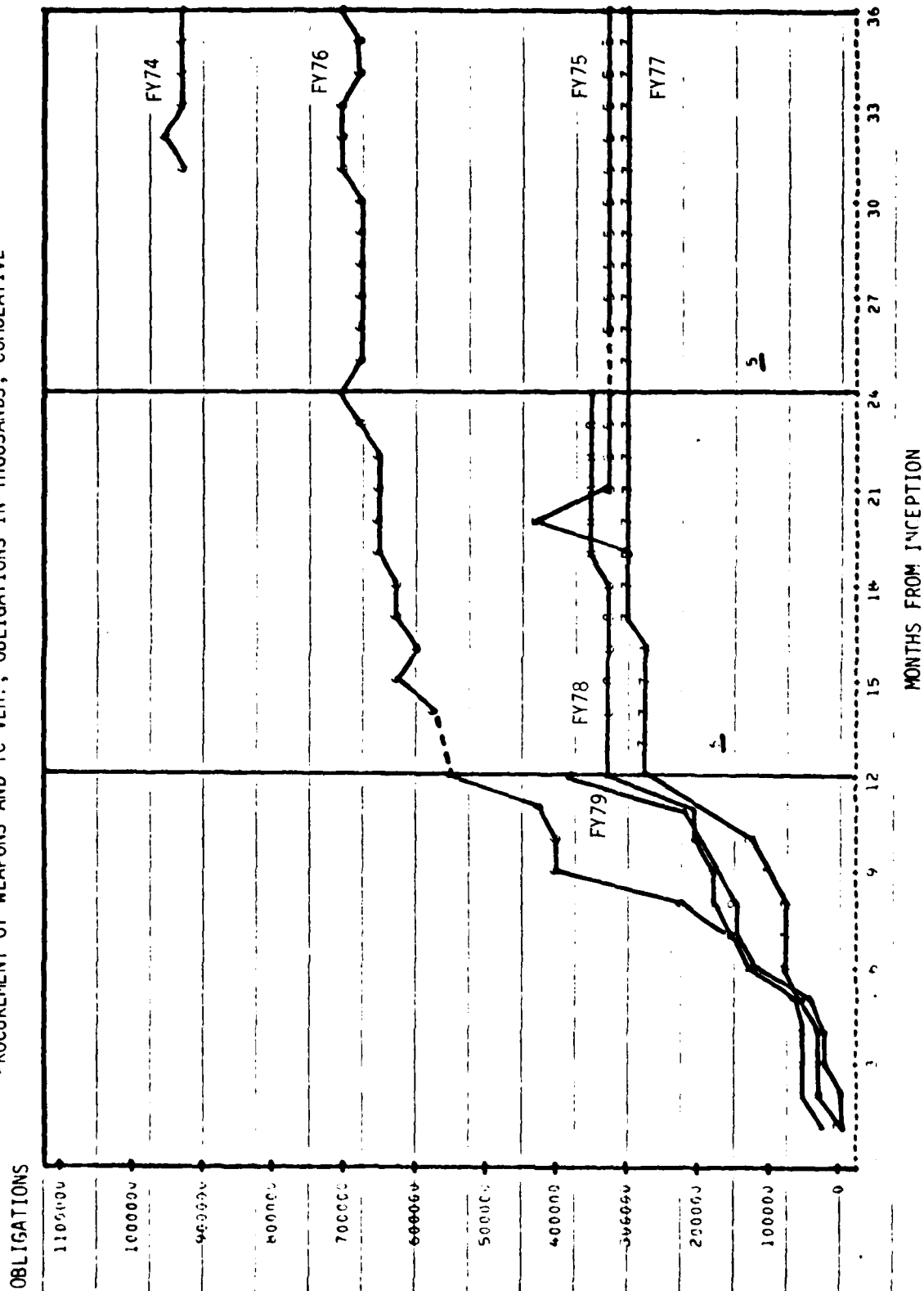
PROCUREMENT OF WEAPONS AND TC VEH., OBLIGATION FACTORS

C-12
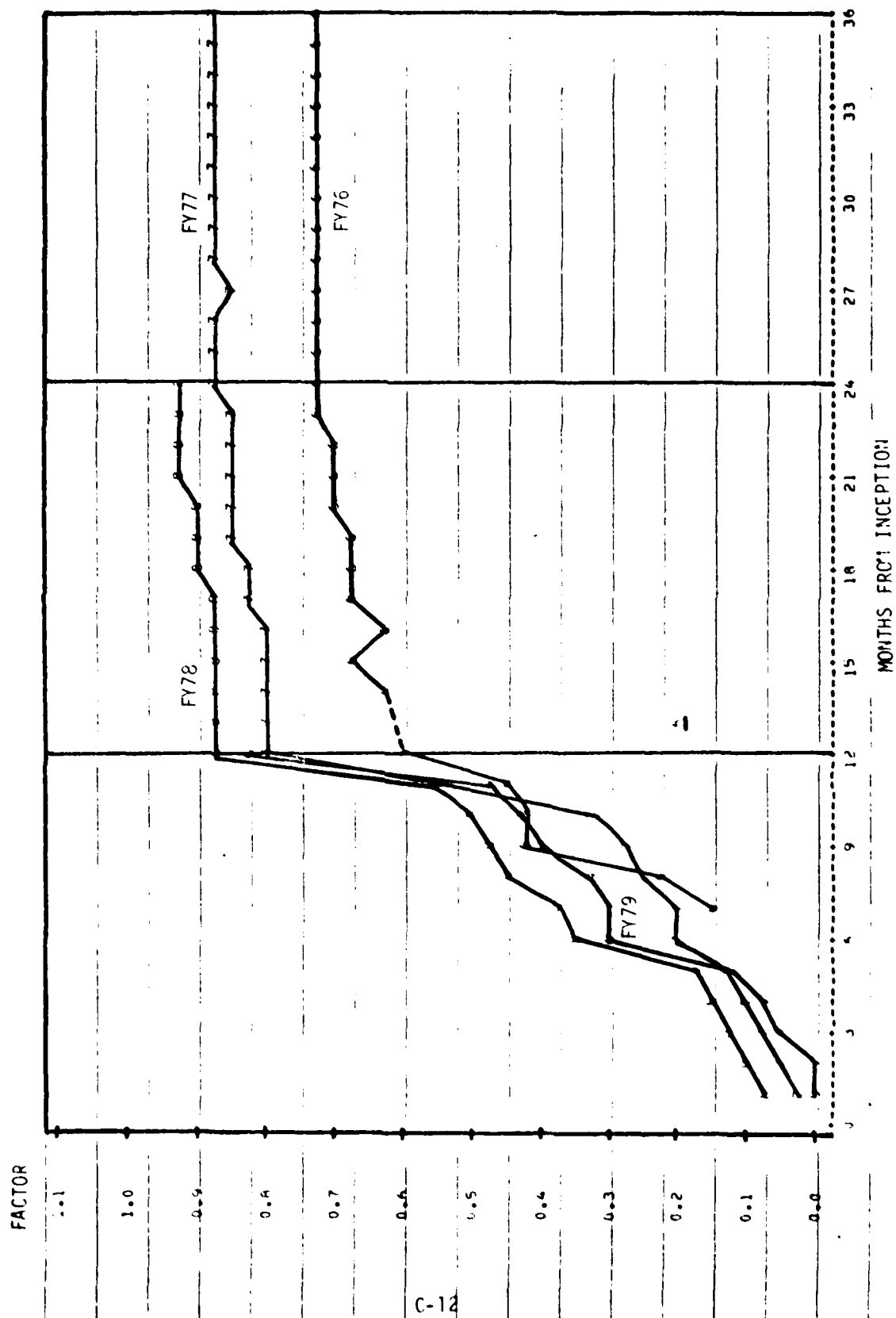
PROCUREMENT OF AMMUNITION
FOREIGN MILITARY SALES ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	6419	98208	0	34876	54941	0.128	0.189
2	.	.	.	1390	212690	3326	72469	121439	0.264	0.419
3	.	.	.	54631	311590	6630	124284	163978	0.499	0.532
4	.	.	.	134954	207141	28672	123589	89776	0.620	0.266
5	.	.	.	143710	212667	37878	131418	88040	0.677	0.233
6	.	.	.	133907	216387	82371	144222	67601	0.826	0.075
7	.	.	105453	170289	257102	105222	159517	71902	0.890	0.300
8	.	.	261961	267639	265987	121319	229227	71978	1.263	0.286
9	.	.	203957	261419	288580	130459	221107	69972	1.234	0.324
10	.	.	235982	211165	299915	133438	220125	68830	1.212	0.202
11	.	.	296029	204222	315056	137980	235822	80354	1.283	0.174
12	.	.	224796	165808	284374	90663	191410	82790	1.000	0.000
13	.	.	238700	158032	264379	.	227037	63976	1.005	0.055
14	.	.	192823	162992	284672	.	213496	63419	0.947	0.078
15	.	.	182379	160919	290217	.	211172	69291	0.934	0.109
16	.	.	259066	161194	292123	.	237461	68086	1.051	0.092
17	.	.	243338	160790	293408	.	245845	73832	1.087	0.153
18	.	.	255421	160831	294105	.	236786	68563	1.047	0.084
19	.	591426	255468	161076	296657	.	326232	185714	1.051	0.083
20	.	197056	258046	161083	292249	.	452114	4333536	1.049	0.090
21	.	495828	258075	161594	294832	.	302382	140183	1.053	0.088
22	.	495409	258122	161595	295442	.	302642	140342	1.054	0.088
23	.	497142	255322	150812	261713	.	291247	146376	0.989	0.128
24	.	501543	230413	147775	235732	.	278866	153816	0.915	0.100
25	.	505	220104	147898	.	.	272135	156864	0.936	0.062
26	.	449846	220038	147901	.	.	272595	157684	0.935	0.061
27	.	450022	220395	147910	.	.	272776	157720	0.936	0.062
28	.	450146	219451	150560	.	.	273519	156838	0.943	0.049
29	.	450157	220651	150560	.	.	273890	156658	0.945	0.053
30	.	447435	220942	150577	.	.	272985	155121	0.945	0.053
31	265255	448070	221153	150584	.	.	271266	126979	0.946	0.053
32	530213	446258	220915	150920	.	.	337079	180159	0.946	0.051
33	262806	446800	220703	151050	.	.	270340	126345	0.946	0.050
34	262812	446442	220722	144294	.	.	268597	128339	0.926	0.079
35	264794	420446	160658	145746	.	.	247989	126557	0.798	0.115
36	264428	441414	202051	144384	.	.	245420	125152	0.792	0.112

PROCUREMENT OF AMMUNITION
MILITARY ASSISTANCE PROGRAM ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	409	446	0	285	248	0.059	0.070
2	.	.	.	882	1076	0	653	573	0.131	0.149
3	.	.	.	1067	2496	425	1329	1060	0.245	0.104
4	.	.	.	1067	4753	425	2082	2336	0.314	0.148
5	.	.	.	1147	7355	429	2977	3808	0.403	0.264
6	.	.	.	1203	8124	565	3297	4192	0.448	0.278
7	.	.	4041	1324	9068	1122	3889	3700	0.498	0.229
8	.	.	8575	1707	9492	1399	5218	4242	0.647	0.154
9	.	.	5049	2025	10444	2543	4965	3759	0.728	0.245
10	.	.	11354	2752	10722	2544	6846	4855	0.926	0.041
11	.	.	11759	3016	10875	2704	7088	4897	0.973	0.033
12	.	.	12502	3006	10875	2851	7309	5101	1.000	0.000
13	.	.	8656	3006	10875	.	7512	4057	0.897	0.178
14	.	.	8428	3008	10706	.	7381	3954	0.886	0.184
15	.	.	8656	3016	10704	.	7329	3929	0.883	0.192
16	.	.	11096	3016	10704	.	8272	4556	0.958	0.062
17	.	.	11178	3016	10704	.	8266	4550	0.958	0.063
18	.	.	11053	3016	10704	.	8258	4543	0.957	0.064
19	.	157169	11055	3018	10704	.	45987	75546	0.958	0.064
20	.	308088	11053	3018	10704	.	83216	149961	0.957	0.064
21	.	149735	11051	3018	10704	.	43627	70836	0.957	0.064
22	.	147633	11051	3018	10704	.	43152	69886	0.957	0.064
23	.	147956	10657	2996	11005	.	43156	69964	0.954	0.088
24	.	147670	10641	2998	10606	.	42979	69887	0.941	0.079
25	.	147568	10645	2998	.	.	53737	81350	0.924	0.103
26	.	147545	10645	2998	.	.	53743	81360	0.924	0.103
27	.	147495	10645	2998	.	.	53713	81308	0.924	0.103
28	.	147011	10692	2998	.	.	53567	81016	0.926	0.100
29	.	146590	10594	2996	.	.	53427	80773	0.926	0.100
30	.	146590	10694	2998	.	.	53427	80773	0.926	0.100
31	299286	133633	10694	4639	.	.	112112	138251	1.199	0.486
32	597752	133790	10094	1691	.	.	185982	281050	0.709	0.207
33	298481	133731	10292	2999	.	.	111376	138410	0.910	0.123
34	298484	133730	10292	2999	.	.	111376	138411	0.910	0.123
35	298453	133730	10279	2999	.	.	111365	138400	0.910	0.124
36	298474	133729	10279	2993	.	.	111369	138411	0.909	0.123

PROCUREMENT OF AMMUNITION
OTHER ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	•	•	•	13905	17470	140	10505	9152	0.037	0.032
2	•	•	•	43187	249790	48141	113706	117878	0.336	0.297
3	•	•	•	69430	146180	88635	101415	39939	0.320	0.073
4	•	•	•	101683	209243	192597	167841	57896	0.523	0.058
5	•	•	•	127777	220447	225764	191329	55102	0.604	0.033
6	•	•	•	121993	284021	263604	223206	88245	0.688	0.122
7	•	•	169073	190372	313975	269195	225654	82197	0.813	0.047
8	•	•	261510	193002	315895	283309	263429	51999	1.028	0.373
9	•	•	136300	194962	329933	336966	250290	100660	0.890	0.053
10	•	•	144569	193399	348329	342574	257218	103842	0.915	0.050
11	•	•	147856	190643	367343	345524	263142	110043	0.933	0.066
12	•	•	164434	225512	369281	353094	277430	99759	1.000	0.000
13	•	•	163937	222410	369513	•	251953	105924	0.998	0.003
14	•	•	159392	225366	368801	•	251186	107066	0.993	0.023
15	•	•	157191	223147	368977	•	249772	108374	0.985	0.027
16	•	•	163373	223589	371352	•	252771	107016	1.001	0.008
17	•	•	161752	223574	372116	•	252481	108120	0.998	0.014
18	•	•	161311	224613	371870	•	252598	108033	0.998	0.017
19	•	323088	162228	224589	371528	•	270558	94671	1.000	0.014
20	•	610395	162675	224671	366026	•	341117	198939	0.996	0.012
21	•	285572	161545	225286	367834	•	260309	88001	0.996	0.016
22	•	272583	159841	225875	366646	•	255236	86932	0.993	0.023
23	•	272062	159252	224377	365700	•	255600	87312	0.989	0.021
24	•	273403	159072	222134	360759	•	253967	85285	0.980	0.017
25	•	317752	158955	222023	•	•	232243	80487	0.981	0.024
26	•	318798	159453	222147	•	•	233466	80273	0.983	0.022
27	•	318743	159239	219438	•	•	232473	80547	0.976	0.014
28	•	318224	159157	219764	•	•	232385	80276	0.977	0.016
29	•	315574	159076	219942	•	•	232531	80491	0.977	0.017
30	•	314454	158216	219280	•	•	231988	80878	0.973	0.018
31	203998	304686	158213	219280	•	•	221594	61291	0.973	0.018
32	408024	304886	158198	218656	•	•	272441	108597	0.971	0.016
33	203102	304477	158987	217140	•	•	220927	60962	0.970	0.008
34	203108	304478	158979	215895	•	•	220615	60994	0.967	0.004
35	203044	304202	158918	216416	•	•	220645	60882	0.968	0.006
36	203332	302141	157639	216420	•	•	219883	60351	0.964	0.012

PROCUREMENT OF AMMUNITION
TOTAL(F4S+MAP+OTHER) ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	21033	116124	140	45766	61821	0.076	0.089
2	.	.	.	45459	463556	51467	186827	239673	0.310	0.336
3	.	.	.	125128	460266	95690	227028	202526	0.409	0.251
4	.	.	.	237704	421137	221694	293512	110816	0.579	0.073
5	.	.	.	272634	440469	264071	325725	99464	0.650	0.054
6	.	.	238567	257103	508532	346540	370725	127447	0.733	0.066
7	.	.	532049	361985	580145	375539	389059	141513	0.779	0.205
8	.	.	345318	462348	591074	406027	497875	80730	1.010	0.137
9	.	.	391915	454406	631766	469968	476365	117879	0.966	0.206
10	.	.	445643	407316	658966	478556	484188	122478	0.971	0.131
11	.	.	502132	398081	693274	487208	506052	130018	1.010	0.087
12	.	.	411293	391326	664530	446608	501149	117941	1.000	0.000
13	.	.	360643	383448	664767	.	486503	155008	0.933	0.099
14	.	.	347836	391364	664179	.	472062	167086	0.906	0.163
15	.	.	433535	387082	669898	.	468272	175712	0.897	0.177
16	.	.	456154	387799	674179	.	498504	153848	0.956	0.081
17	.	.	427745	387380	676228	.	506592	150881	0.972	0.057
18	.	.	428749	348460	676679	.	497641	156293	0.954	0.090
19	.	1074483	431994	388683	679189	.	642776	315208	0.956	0.090
20	.	2016039	436671	388772	668979	.	876446	769649	0.953	0.081
21	.	931335	429014	389898	673370	.	606319	250214	0.956	0.085
22	.	916025	425251	390488	672792	.	602030	243693	0.955	0.087
23	.	917150	400126	378187	639418	.	590004	245956	0.925	0.068
24	.	923116	389704	372907	607097	.	575812	254057	0.888	0.081
25	.	914724	390136	372919	.	.	559116	308080	0.865	0.125
26	.	916229	390279	373046	.	.	559804	308792	0.865	0.125
27	.	916240	389710	370346	.	.	558962	309590	0.862	0.120
28	.	915381	390724	373322	.	.	559471	308336	0.865	0.126
29	.	915323	349852	373500	.	.	559848	307971	0.866	0.125
30	.	912511	390060	372855	.	.	558406	306782	0.865	0.125
31	768533	886789	389807	371554	.	.	604234	262578	0.863	0.122
32	1535989	884944	389992	371267	.	.	795502	5479902	0.863	0.122
33	764389	885008	390070	371189	.	.	602642	261207	0.863	0.122
34	764404	884090	330155	363188	.	.	600588	263655	0.852	0.102
35	766291	858578	328210	365161	.	.	579999	271276	0.795	0.195
36	766621	852059	.	363797	.	.	577672	270163	0.792	0.195

PROCUREMENT OF AMMUNITION
FOREIGN MILITARY SALES OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	•	•	•	0	0	0	0	0	0.000	0.000
2	•	•	•	53	68	0	40	36	0.000	0.000
3	•	•	•	1260	39640	363	13754	22422	0.050	0.077
4	•	•	•	1677	54718	989	19128	30824	0.071	0.105
5	•	•	•	4948	68157	1187	24764	37626	0.094	0.126
6	•	•	•	13818	78574	2113	31502	41184	0.128	0.132
7	•	•	17236	26854	91003	3664	34689	38729	0.150	0.124
8	•	•	40740	30133	96197	5466	43134	38338	0.190	0.114
9	•	•	45940	35340	131815	23079	59044	49405	0.284	0.122
10	•	•	47863	45129	139246	25064	64321	50973	0.313	0.121
11	•	•	56938	75217	145652	35856	78416	47622	0.404	0.111
12	•	•	77644	127376	192406	58307	113933	59861	0.608	0.183
13	•	•	76242	127972	191893	•	132036	57932	0.595	0.227
14	•	•	81676	128990	190389	•	133685	54508	0.604	0.215
15	•	•	92656	125145	190029	•	135943	49576	0.612	0.178
16	•	•	95355	126425	190184	•	137321	48344	0.618	0.175
17	•	•	99259	127110	140849	•	139073	46952	0.626	0.167
18	•	•	106428	126757	193166	•	142117	45363	0.639	0.150
19	•	270917	110440	125684	195946	•	175747	73568	0.646	0.138
20	•	563160	112660	126219	193869	•	248977	212446	0.648	0.133
21	•	297460	110248	125642	196846	•	182549	85391	0.647	0.139
22	•	301602	110282	123512	196565	•	182990	87706	0.642	0.134
23	•	294600	110843	126096	197022	•	182142	83854	0.649	0.139
24	•	310932	127846	131138	199257	•	192293	85668	0.687	0.112
25	•	303347	117106	130870	•	•	185441	106662	0.655	0.190
26	•	307069	138560	131047	•	•	192892	100682	0.703	0.123
27	•	309953	126800	130229	•	•	188994	104768	0.675	0.157
28	•	311117	127061	130156	•	•	189445	105383	0.675	0.155
29	•	312330	127197	127921	•	•	189149	106678	0.669	0.145
30	•	311975	127215	127885	•	•	189025	106478	0.669	0.145
31	168312	313681	127032	127873	•	•	186225	88428	0.668	0.144
32	337143	311219	127919	128135	•	•	226104	113743	0.671	0.144
33	162979	310578	127785	128311	•	•	182413	87016	0.671	0.145
34	169232	308223	127439	128272	•	•	183292	85542	0.670	0.144
35	171864	305999	127479	127900	•	•	184061	85856	0.669	0.144
36	177298	312299	129743	132299	•	•	187910	85754	0.688	0.156

PROCUREMENT OF AMMUNITION
MILITARY ASSISTANCE PROGRAM OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	0	0	0	0	0	0.000	0.000
3	.	.	.	0	24	0	8	14	0.001	0.001
4	.	.	.	19	43	0	21	22	0.003	0.001
5	.	.	.	0	86	0	29	50	0.003	0.003
6	.	.	.	303	473	0	259	240	0.048	0.005
7	.	.	1417	306	867	3	648	626	0.074	0.051
8	.	.	3019	306	2805	·	1533	1599	0.151	0.051
9	.	.	1787	308	4715	252	1766	2091	0.192	0.122
10	.	.	1820	531	5214	457	2006	2229	0.240	0.163
11	.	.	1915	550	5494	507	2109	2330	0.254	0.160
12	.	.	3802	1474	5916	705	2974	2361	0.396	0.166
13	.	.	4522	1474	5878	·	3958	2256	0.464	0.143
14	.	.	4522	1612	5937	·	4024	2205	0.481	0.092
15	.	.	4565	1544	5920	·	4010	2240	0.474	0.104
16	.	.	4489	1550	5925	·	3988	2230	0.473	0.096
17	.	.	4713	1567	5904	·	4060	2240	0.480	0.100
18	.	.	4744	1588	5904	·	4079	2234	0.484	0.090
19	.	236470	5036	1769	5952	·	62307	116123	0.513	0.090
20	.	473082	5077	1776	5949	·	121471	234414	0.515	0.098
21	.	243608	5074	1835	5458	·	63969	119373	0.521	0.097
22	.	237171	5203	1835	5992	·	63038	117403	0.526	0.105
23	.	244028	5382	1435	5992	·	64459	120126	0.531	0.100
24	.	243937	5725	1838	6041	·	64903	120705	0.543	0.092
25	.	86570	5796	1773	.	.	31380	47839	0.527	0.075
26	.	86459	5898	1773	.	.	31380	47753	0.531	0.089
27	.	86490	5847	1773	.	.	31367	47773	0.529	0.083
28	.	86318	5845	1773	.	.	31312	47680	0.529	0.086
29	.	86253	5856	1412	.	.	31177	47749	0.469	0.086
30	.	85797	5855	1412	.	.	31091	47602	0.469	0.000
31	224427	86549	5863	1412	.	.	80813	106522	0.469	0.000
32	455110	86310	5873	1416	.	.	137177	215515	0.470	0.001
33	232521	86124	5877	1416	.	.	81485	107952	0.471	0.001
34	233937	86091	5852	1416	.	.	81824	108618	0.470	0.001
35	233763	86102	5852	1416	.	.	81783	108537	0.470	0.002
36	235451	88407	5903	1755	.	.	82879	109263	0.528	0.079

PROCUREMENT OF AMMUNITION
OTHER OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	•	•	•	0	0	0	0	0	0.000	0.000
2	•	•	•	12761	99962	400	37708	54267	0.110	0.142
3	•	•	•	13688	76718	29280	39895	32828	0.117	0.079
4	•	•	•	15738	106973	34532	52414	48175	0.153	0.119
5	•	•	•	22125	115857	58420	65467	47262	0.193	0.110
6	•	•	•	32005	129440	73380	78275	48902	0.234	0.106
7	•	•	31211	44801	143063	85346	76105	50213	0.255	0.091
8	•	•	74198	59298	158802	115823	102030	44773	0.369	0.087
9	•	•	63497	67655	189480	141286	126980	67526	0.438	0.099
10	•	•	70001	79993	196072	185524	132898	67120	0.460	0.083
11	•	•	75408	101607	207671	212305	149348	70834	0.520	0.073
12	•	•	99139	173015	280795	265932	204720	85023	0.723	0.082
13	•	•	18084	173599	281326	•	157670	132342	0.551	0.382
14	•	•	100096	175301	284939	•	185779	92954	0.722	0.100
15	•	•	101727	175224	286672	•	187874	93119	0.727	0.095
16	•	•	102723	177695	289197	•	189472	93831	0.735	0.097
17	•	•	105235	179025	290962	•	191741	93514	0.744	0.091
18	•	93537	111657	142579	292292	•	195610	91168	0.763	0.076
19	•	187856	112692	181499	291912	•	169860	89733	0.763	0.070
20	•	100613	114953	181767	293081	•	194414	73603	0.769	0.063
21	•	94320	115788	183025	308055	•	176870	94505	0.786	0.073
22	•	100938	118232	182899	309477	•	177482	94995	0.792	0.066
23	•	101411	119155	183588	311435	•	178779	95280	0.797	0.065
24	•	101411	122794	191750	318604	•	183640	97886	0.823	0.068
25	•	263217	112532	191571	•	•	189107	75373	0.772	0.126
26	•	263317	133606	191948	•	•	196244	64893	0.837	0.037
27	•	264403	123295	191695	•	•	193131	70565	0.805	0.080
28	•	264452	123041	142726	•	•	193406	70708	0.806	0.085
29	•	264085	123255	185761	•	•	191035	70564	0.791	0.062
30	•	264146	125337	185182	•	•	191556	69625	0.796	0.051
31	212664	265310	125886	184541	•	•	197102	58096	0.792	0.046
32	423437	265080	126236	184624	•	•	250044	129001	0.798	0.045
33	212561	266294	126700	186221	•	•	197944	58019	0.803	0.048
34	211478	266306	127777	185963	•	•	197881	57514	0.805	0.043
35	215524	265056	128523	184687	•	•	198648	57487	0.805	0.036
36	217012	268206	129999	193896	•	•	202278	57324	0.830	0.058

PROCUREMENT OF AMMUNITION
TOTAL(FMS+MAP+OTHER) OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	12814	100030	400	37748	54294	0.061	0.079
3	.	.	.	14948	116382	29643	53658	54816	0.093	0.072
4	.	.	.	17434	161734	35521	71563	78612	0.122	0.106
5	.	.	.	27073	184100	59607	90260	82880	0.160	0.106
6	.	.	.	46126	208487	75493	110035	86517	0.200	0.102
7	.	.	49864	71961	236933	89010	111442	83873	0.209	0.106
8	.	.	117957	89737	257804	121292	146698	75411	0.281	0.074
9	.	.	117224	103303	326017	204617	187790	102482	0.362	0.132
10	.	.	120664	125653	340532	211045	199474	102781	0.387	0.128
11	.	.	134661	177374	358787	248668	229873	97969	0.455	0.132
12	.	.	180585	301865	479115	324944	321627	122606	0.645	0.191
13	.	.	98848	303045	479097	.	293663	190298	0.564	0.319
14	.	.	186294	305903	481265	.	324487	148361	0.626	0.222
15	.	.	198948	301913	482621	.	327827	143601	0.631	0.205
16	.	.	202567	305670	465306	.	331181	143085	0.638	0.205
17	.	.	209204	307702	487715	.	334874	141230	0.646	0.200
18	.	.	222831	310924	491662	.	341806	137050	0.659	0.189
19	.	600724	278168	308952	493810	.	420414	153358	0.696	0.125
20	.	1224098	232690	309762	492899	.	564862	452837	0.666	0.177
21	.	641081	231110	310502	510859	.	423388	186865	0.674	0.186
22	.	640043	233717	308246	512034	.	423510	186217	0.675	0.181
23	.	640174	235380	311519	514449	.	425381	185413	0.680	0.183
24	.	658280	256435	324720	523902	.	440834	184091	0.710	0.174
25	.	658134	235434	324214	.	.	459927	222883	0.649	0.254
26	.	658716	278064	374768	.	.	420516	207605	0.692	0.195
27	.	660836	259942	323697	.	.	413492	216869	0.668	0.224
28	.	661087	255947	324655	.	.	414163	217268	0.670	0.226
29	.	662071	256318	315094	.	.	411361	219616	0.658	0.208
30	.	662120	254417	314479	.	.	411672	218698	0.659	0.204
31	610403	665546	258781	313826	.	.	462139	205514	0.659	0.203
32	1215690	663409	260028	314175	.	.	613326	439569	0.660	0.202
33	608061	662996	260370	315948	.	.	461844	203075	0.663	0.204
34	614647	660620	251058	315651	.	.	462997	203747	0.663	0.203
35	621151	660957	251854	314003	.	.	464491	205629	0.662	0.199
36	629761	668712	265647	327950	.	.	473068	205743	0.684	0.219

PROCUREMENT OF AMMO, ORDERS IN THOUSANDS, CUMULATIVE

ORDERS

2000000

1750000

1500000

1250000

1000000

750000

500000

250000

0

0   3   6   9   12   15   18   21   24   27   30   33   36

MONTHS FROM INCEPTION

FY75
FY74
FY76
FY77
FY79
FY78
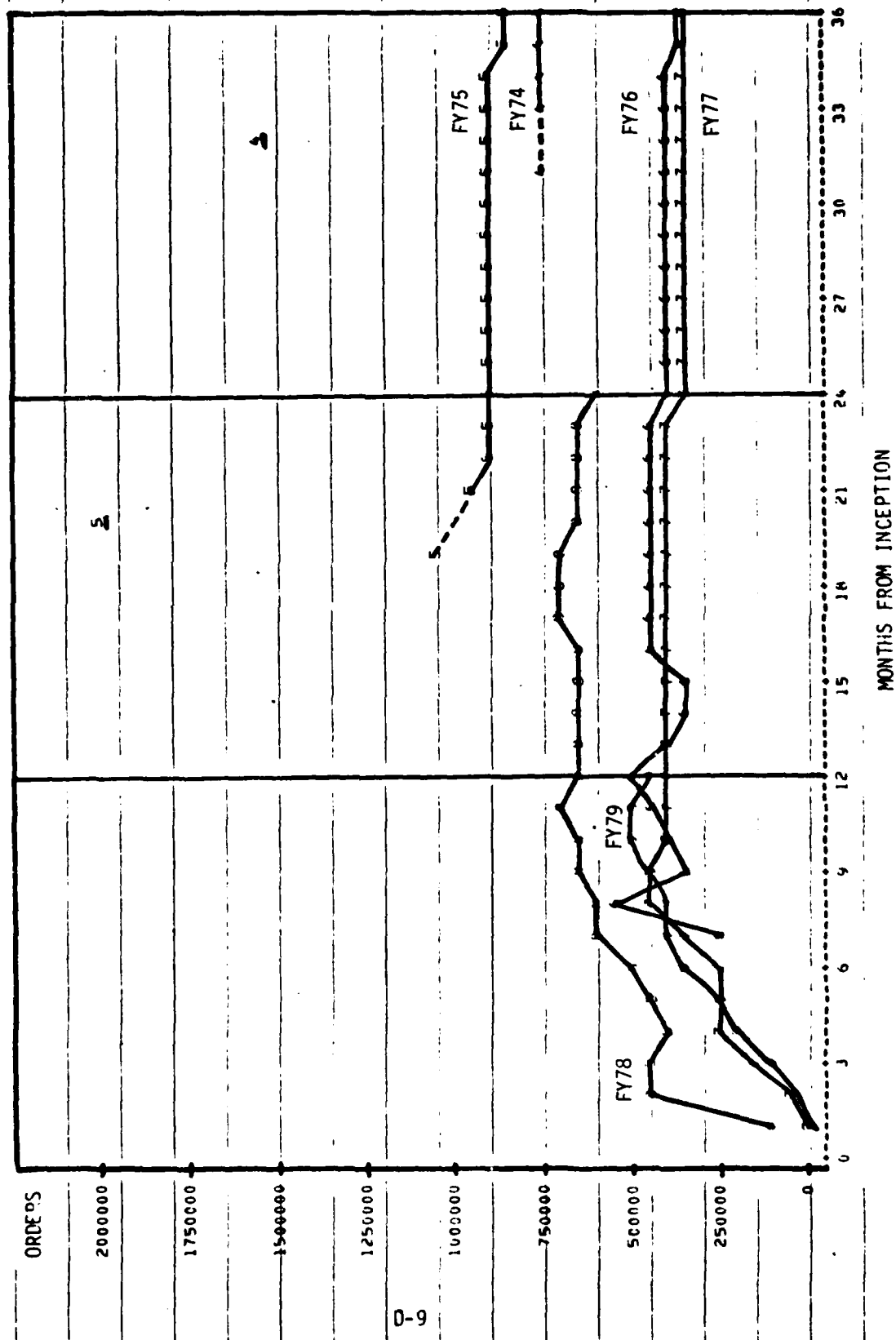
PROCUREMENT OF AMMO, ORDER FACTORS
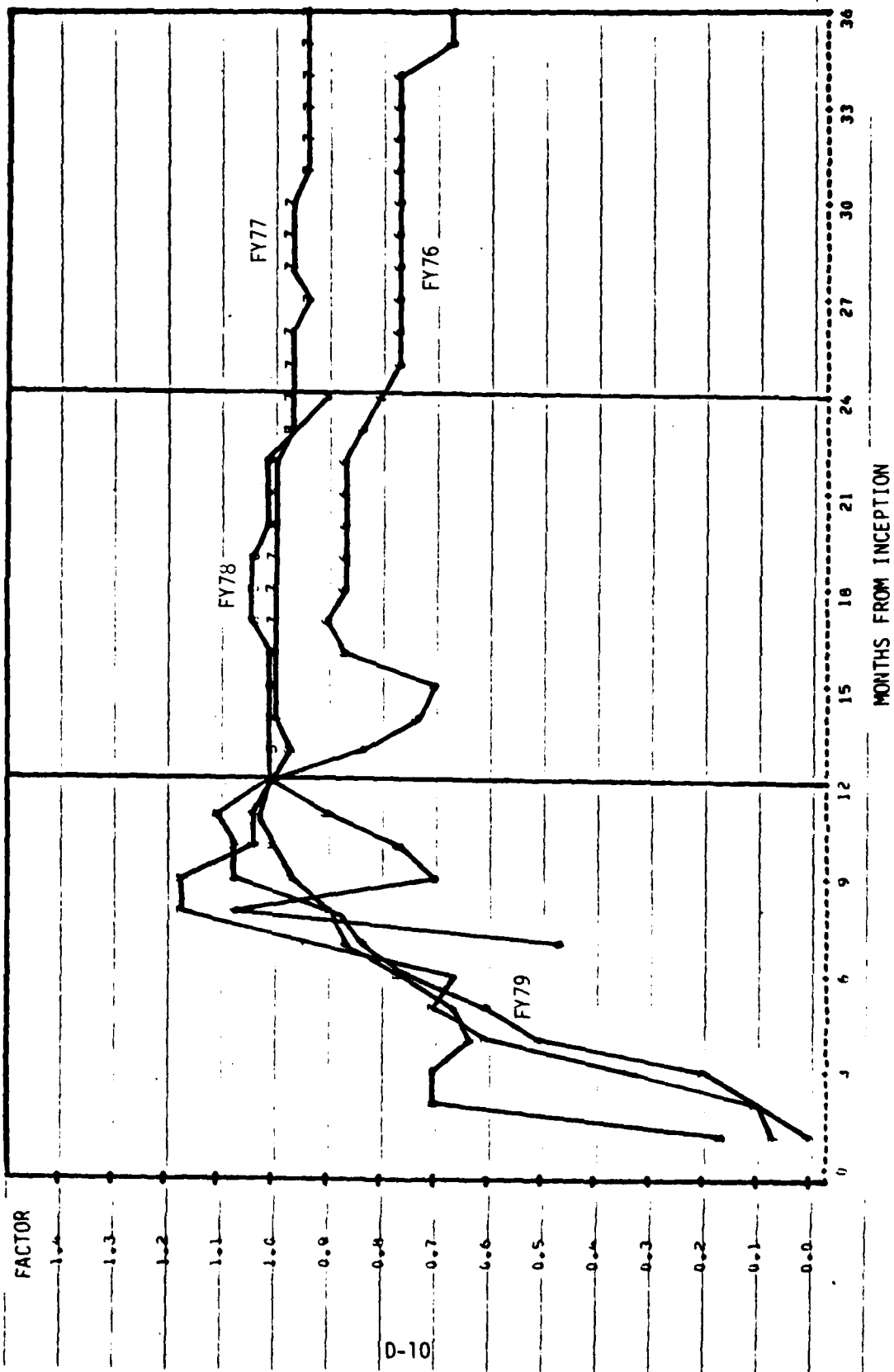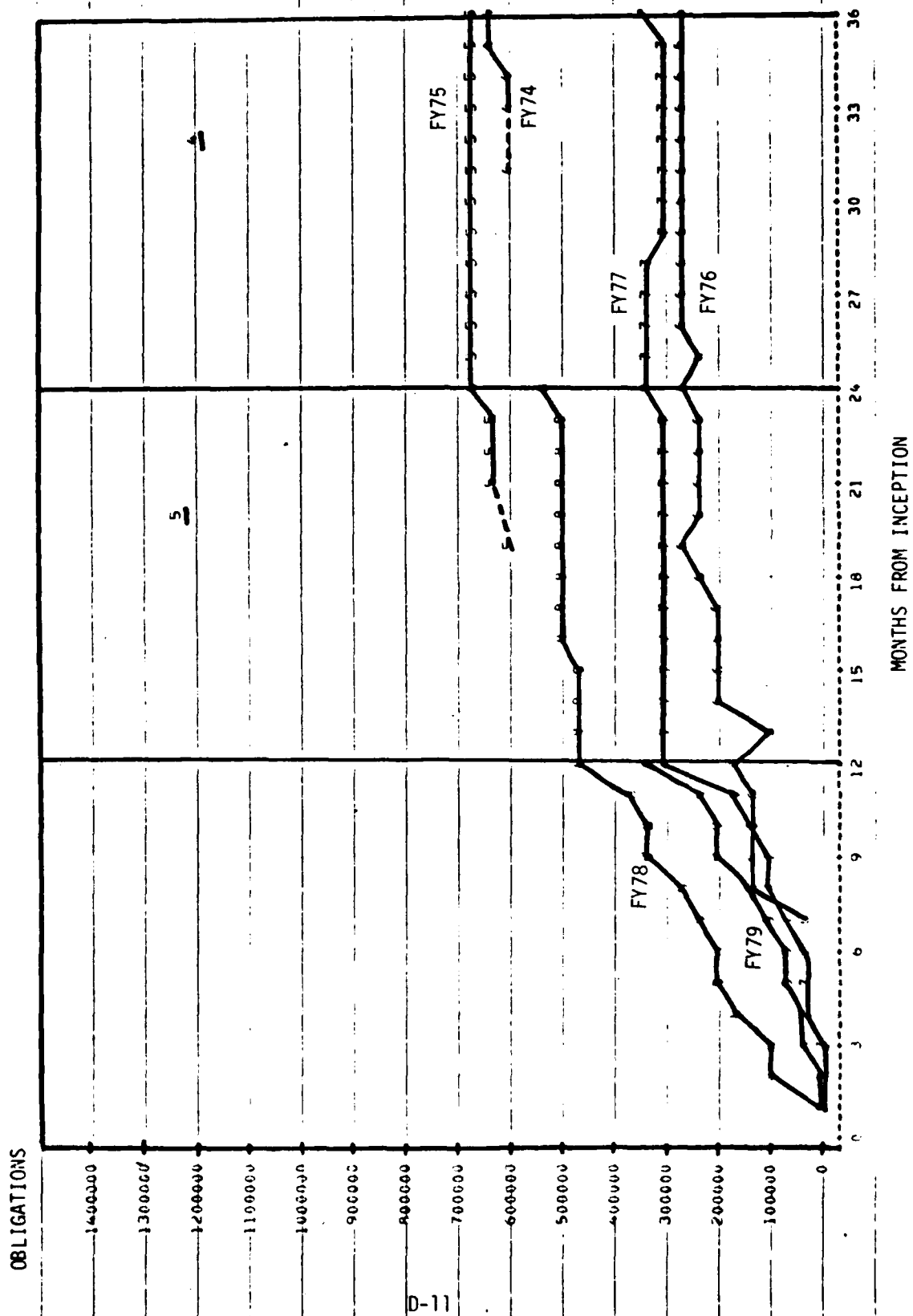
FACTOR

MONTHS FROM INCEPTION

FY77
FY76
FY78
FY79

D-10

PROCUREMENT OF AMMO, OBLIGATIONS IN THOUSANDS, CUMULATIVE

OBLIGATIONS

1400000
1300000
1200000
1100000
1000000
900000
800000
700600
600000
500000
400000
300000
200000
100000
0

MONTHS FROM INCEPTION

0 3 6 9 12 15 18 21 24 27 30 33 36

FY75
FY74
FY77
FY76
FY78
FY79

D-11

PROCUREMENT OF AMMO, OBLIGATION FACTORS

FACTOR

MONTHS FROM INCEPTION
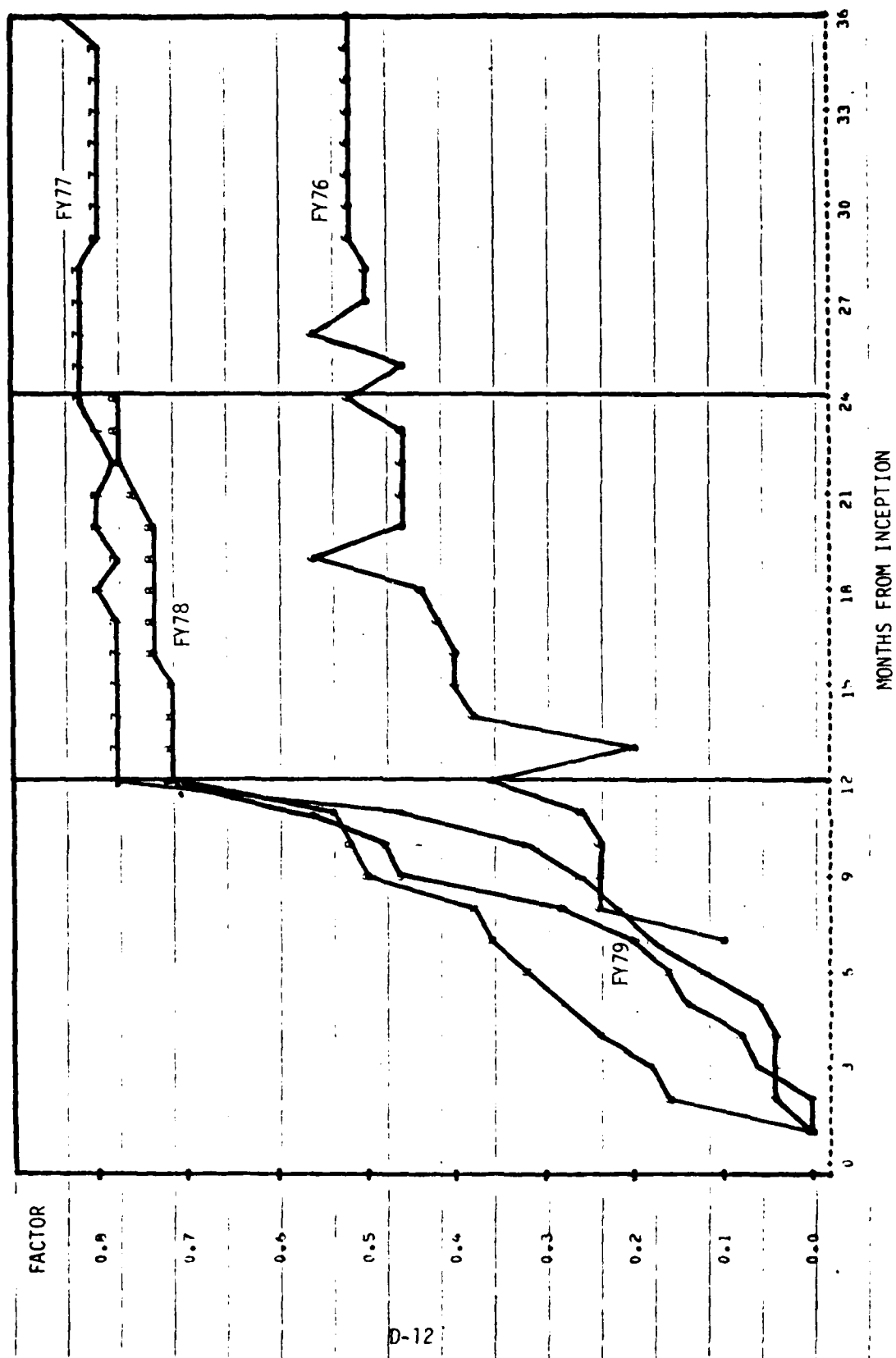
PROCUREMENT OF OTHER
FOREIGN MILITARY SALES ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1				520	6379	9	2303	3539	0.033	0.052
2				37752	21861	3429	21014	17177	0.248	0.195
3				66105	10772	14973	30617	30805	0.325	0.322
4				62029	29680	32438	41382	17934	0.449	0.197
5				68747	31100	37594	45814	20125	0.494	0.214
6				74109	48262	43396	55256	16508	0.612	0.232
7			158433	79542	57972	113405	102338	43807	0.799	0.135
8			173355	80565	62115	119055	108775	49161	0.843	0.130
9			153557	99839	70337	131709	113863	36451	0.930	0.231
10			166581	93832	75015	134709	117534	41111	0.950	0.217
11			201871	106098	74496	132672	128784	54218	1.010	0.163
12			263196	95003	68195	124913	137827	86731	1.000	0.000
13			79804	92730	68352		80295	12196	0.761	0.396
14			262935	92310	67600		140948	106364	0.987	0.014
15			276517	91709	67439		145222	114351	1.002	0.044
16			263353	92278	67463		141035	106664	0.387	0.015
17			261600	91972	67139		140304	105949	0.982	0.013
18			252032	92020	67392		137315	100538	0.972	0.015
19		235517	262470	92387	67322		164424	98802	0.986	0.012
20		251454	263315	91984	66707		168365	103421	0.982	0.017
21		235201	259950	92075	66600		163457	98209	0.978	0.009
22		235007	259083	91075	66673		162960	98097	0.974	0.013
23		235339	250384	90636	65329		160435	95962	0.954	0.003
24		235659	241307	86848	60928		156086	95533	0.908	0.013
25		65575	232054	86782			128070	90686	0.898	0.022
26		234852	237070	86738			186220	86161	0.907	0.009
27		235204	234264	86773			185414	85427	0.902	0.016
28		235312	235526	87035			185958	85670	0.905	0.015
29		233908	236753	87426			186029	85405	0.910	0.015
30		233757	236305	86518			185527	85753	0.904	0.009
31	253805	230156	235207	85907			201269	77577	0.899	0.007
32	263328	229121	235185	85911			203386	79722	0.899	0.008
33	246705	221865	236170	86445			197796	74929	0.904	0.009
34	249854	221074	233975	84720			197406	76040	0.890	0.002
35	250614	222042	227638	84539			196208	75466	0.877	0.018
36	247836	218018	216373	82769			191249	73751	0.847	0.035

PROCUREMENT OF OTHER
MILITARY ASSISTANCE PROGRAM ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	736	422	0	386	369	0.030	0.031
2	.	.	.	587	832	311	577	261	0.041	0.018
3	.	.	.	617	485	2508	1203	1132	0.080	0.068
4	.	.	.	1491	5436	2529	3152	2045	0.210	0.119
5	.	.	.	1538	5528	2592	3219	2068	0.215	0.120
6	.	.	.	4882	6466	2697	4682	1892	0.331	0.139
7	.	.	7381	6906	8116	3470	5968	2542	0.482	0.181
8	.	.	11238	7775	9851	3597	9115	3331	0.561	0.227
9	.	.	10842	8716	12570	4706	9209	3390	0.635	0.229
10	.	.	13785	8422	13563	5721	9623	3344	0.659	0.213
11	.	.	43232	9430	13720	11207	19397	15987	1.299	1.019
12	.	.	15303	11874	15717	15888	14696	1897	1.000	0.000
13	.	.	6299	12064	15406	.	11256	4607	0.803	0.339
14	.	.	12817	12680	15849	.	13782	1791	0.971	0.120
15	.	.	13223	12670	16113	.	14002	1849	0.985	0.107
16	.	.	14139	12697	16791	.	14542	2077	1.021	0.084
17	.	.	14401	12221	16536	.	14386	2158	1.007	0.059
18	.	.	14507	12161	17072	.	14580	2456	1.019	0.069
19	.	20150	14595	12339	17344	.	16110	3388	1.032	0.075
20	.	21114	14594	13598	17171	.	16620	3354	1.064	0.099
21	.	19972	14399	14491	17314	.	16542	2659	1.087	0.141
22	.	19742	14513	15772	17457	.	16921	2348	1.129	0.191
23	.	19751	14252	15969	17196	.	15842	2399	1.123	0.208
24	.	17078	14402	15795	16763	.	16510	1968	1.113	0.199
25	.	15778	14402	15944	.	.	15708	1205	1.162	0.284
26	.	19317	14148	15949	.	.	15472	2625	1.134	0.296
27	.	13320	14414	16230	.	.	16655	2480	1.154	0.300
28	.	19407	14276	16253	.	.	16629	2612	1.149	0.311
29	.	19410	14252	16258	.	.	15643	2596	1.151	0.309
30	36361	19417	14217	16216	.	.	16617	2624	1.147	0.309
31	30600	19455	14204	16233	.	.	20063	7198	1.148	0.310
32	28819	19498	14216	16242	.	.	20139	7306	1.148	0.310
33	28680	19447	14228	16311	.	.	19701	6446	1.152	0.314
34	29133	18154	14195	16269	.	.	19325	6443	1.169	0.313
35	32334	18049	14153	14346	.	.	18923	7038	1.067	0.200
36		16057	13952	13089	.	.	19983	9022	1.007	0.135

E-2

PROCUREMENT OF OTHER
OTHER ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	682	413	24	373	331	0.004	0.005
2	.	.	.	2791	4965	6071	4609	1669	0.043	0.005
3	.	.	.	35166	16201	27702	26356	9554	0.288	0.202
4	.	.	.	45637	32960	58896	45831	12969	0.467	0.203
5	.	.	.	57131	51694	71600	60142	10289	0.607	0.214
6	.	.	.	59381	81110	97518	79336	19130	0.765	0.111
7	.	.	64610	59672	82361	109435	79020	22496	0.788	0.104
8	.	.	63956	59999	86378	113463	82349	23434	0.820	0.095
9	.	.	60193	63695	115080	118687	96914	25513	0.961	0.057
10	.	.	63649	67044	115646	120003	99086	24276	0.987	0.070
11	.	.	44901	64353	120670	124421	88511	40147	0.854	0.225
12	.	.	46224	68232	125024	125635	101279	28727	1.000	0.000
13	.	.	29799	68704	99800	.	66098	35078	0.717	0.338
14	.	.	86544	69926	125989	.	93820	29219	1.007	0.003
15	.	.	87201	68410	126020	.	94010	29207	1.009	0.002
16	.	.	87226	67896	124736	.	93287	28900	1.001	0.009
17	.	.	87290	67177	126890	.	93786	30382	1.004	0.017
18	.	.	95510	66063	126445	.	96006	30194	1.029	0.071
19	.	58691	90112	66070	127998	.	85618	31332	1.012	0.040
20	.	59626	90184	66664	126887	.	85840	30324	1.013	0.035
21	.	58622	86280	66607	126797	.	84577	30452	0.997	0.019
22	.	57941	85670	66448	126936	.	84249	30731	0.994	0.021
23	.	57083	85416	70406	126228	.	85084	29646	1.013	0.024
24	.	54693	85047	70603	146074	.	90109	38837	1.063	0.094
25	.	23652	84393	70562	.	.	59708	32023	1.009	0.035
26	.	58950	89743	70376	.	.	73023	15566	1.036	0.007
27	.	59013	82043	70364	.	.	70473	11515	0.991	0.056
28	.	58799	84424	70395	.	.	71273	12735	1.005	0.037
29	.	55704	84419	69929	.	.	71114	12754	1.002	0.032
30	.	58793	84585	69939	.	.	71173	12842	1.003	0.031
31	43958	59063	84308	70085	.	.	64349	17080	1.002	0.035
32	44125	58995	84395	69946	.	.	64365	17037	1.002	0.033
33	47959	59071	84411	69927	.	.	65332	15563	1.002	0.032
34	45477	58944	84222	69812	.	.	64616	16630	1.000	0.013
35	43699	57750	85534	67267	.	.	63613	17536	0.989	0.004
36	44055	57153	84918	67074	.	.	63305	17217	0.984	0.001

PROCUREMENT OF OTHER
TOTAL(F4S+MAP+OTHER) ORDERS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	1938	7214	33	3062	3720	0.015	0.018
2	.	.	.	41130	27658	9811	26200	15710	0.135	0.099
3	.	.	.	101888	27458	45183	58176	38879	0.294	0.250
4	.	.	.	109157	68076	93863	90365	20263	0.434	0.164
5	.	.	.	127416	88322	111786	109175	19677	0.524	0.176
6	.	.	.	138372	135839	143611	139274	3964	0.661	0.126
7	.	.	232424	146120	149449	226310	166326	47466	0.759	0.101
8	.	.	254159	148339	158344	236115	199239	53663	0.798	0.085
9	.	.	254602	172250	197988	255102	219986	41609	0.898	0.133
10	.	.	271015	169298	204224	260433	226243	47962	0.917	0.116
11	.	.	289704	179861	208688	268300	236693	51023	0.958	0.109
12	.	.	364263	175109	208038	256436	253462	82961	1.000	0.000
13	.	.	158892	173498	183558	.	157649	36511	0.730	0.361
14	.	.	362296	173916	209438	.	248550	100095	0.998	0.007
15	.	.	376941	173189	209572	.	253234	108667	1.010	0.023
16	.	.	364730	172871	208990	.	248864	101955	0.998	0.009
17	.	.	363491	171370	210505	.	248475	101516	0.996	0.017
18	.	.	362549	170244	210409	.	247901	101349	0.994	0.021
19	.	313968	367177	170796	212664	.	266151	90270	1.002	0.024
20	.	332199	358003	172246	210765	.	270825	94079	1.002	0.016
21	.	313795	350619	173173	210711	.	264575	87374	0.997	0.014
22	.	312090	359266	173295	211066	.	264129	86593	0.997	0.015
23	.	313623	350054	177411	208753	.	262360	82396	0.993	0.028
24	.	313035	340776	173244	223766	.	262704	77776	1.000	0.071
25	.	105891	331349	173288	.	.	203486	115757	0.950	0.057
26	.	313121	340951	173063	.	.	275715	89982	0.962	0.037
27	.	313537	330721	173367	.	.	272542	86316	0.949	0.058
28	.	313720	334176	173683	.	.	273860	87356	0.955	0.053
29	.	312312	335434	173613	.	.	273786	87520	0.956	0.050
30	.	312159	335110	172673	.	.	273317	87912	0.953	0.047
31	328124	308654	333719	172225	.	.	285681	76396	0.950	0.048
32	338053	307014	333794	172099	.	.	287890	78358	0.950	0.047
33	323483	300343	334815	172683	.	.	282831	74820	0.953	0.047
34	324011	298172	332392	170801	.	.	281344	75121	0.944	0.044
35	323446	298041	327335	166152	.	.	278744	76177	0.924	0.036
36	324235	291738	315243	162932	.	.	273537	74999	0.898	0.046

PROCUREMENT OF OTHER
FOREIGN MILITARY SALES OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	0	2808	0	936	1621	0.014	0.024
3	.	.	.	10774	1329	4	4036	5873	0.044	0.061
4	.	.	.	25130	3477	702	9770	13375	0.107	0.138
5	.	.	.	25529	4790	2997	11105	12523	0.121	0.130
6	.	.	.	27291	17299	5487	16692	10915	0.195	0.132
7	.	.	30824	28086	17736	40868	44384	32376	0.307	0.037
8	.	.	37094	30784	21939	44392	48752	34038	0.343	0.025
9	.	.	101353	43921	27053	66157	59624	32105	0.443	0.067
10	.	.	107944	46822	31727	67412	63476	33057	0.477	0.054
11	.	.	110695	46151	33673	82324	68211	35041	0.515	0.102
12	.	.	156541	61679	41801	91281	87826	50119	0.647	0.060
13	.	.	35773	61897	41698	.	45456	13697	0.466	0.287
14	.	.	166441	63651	42307	.	90800	66371	0.641	0.026
15	.	.	154011	63185	44248	.	90681	64721	0.646	0.020
16	.	.	166544	63797	45885	.	92075	65111	0.659	0.023
17	.	168722	164423	64069	45943	.	91612	64047	0.658	0.028
18	.	221151	157490	66088	46001	.	93193	65122	0.669	0.030
19	.	172018	159320	68404	46797	.	113311	64931	0.683	0.038
20	.	172119	159712	69063	47045	.	126745	82543	0.687	0.041
21	.	169605	172774	69477	48024	.	115573	66196	0.697	0.038
22	.	170214	172107	69560	48144	.	115483	65973	0.692	0.040
23	.	45674	179204	69762	48341	.	116578	67128	0.708	0.027
24	.	173358	141456	69751	49683	.	117951	67898	0.718	0.024
25	.	173531	183195	69605	.	.	99488	73465	0.714	0.026
26	.	173505	179183	69599	.	.	140717	61658	0.707	0.037
27	.	173563	185259	69346	.	.	142712	63807	0.717	0.018
28	.	173575	183066	69004	.	.	141858	63275	0.711	0.022
29	.	174288	183297	67836	.	.	141565	64037	0.705	0.012
30	.	174230	183414	68198	.	.	141729	63869	0.707	0.015
31	207203	173730	182697	68680	.	.	158217	61303	0.709	0.020
32	211239	174381	185637	76171	.	.	161819	59159	0.754	0.068
33	209156	173730	184838	76225	.	.	160990	58415	0.752	0.071
34	209262	174381	184971	76163	.	.	161194	58538	0.752	0.070
35	209354	174493	185146	68558	.	.	159388	62285	0.713	0.013
36	209379	184674	181000	69192	.	.	161111	62554	0.708	0.029

PROCUREMENT OF OTHER
MILITARY ASSISTANCE PROGRAM OBLIGATIONS. IN THOUSANDS
CUMULATIVE FROM INCEPTION.

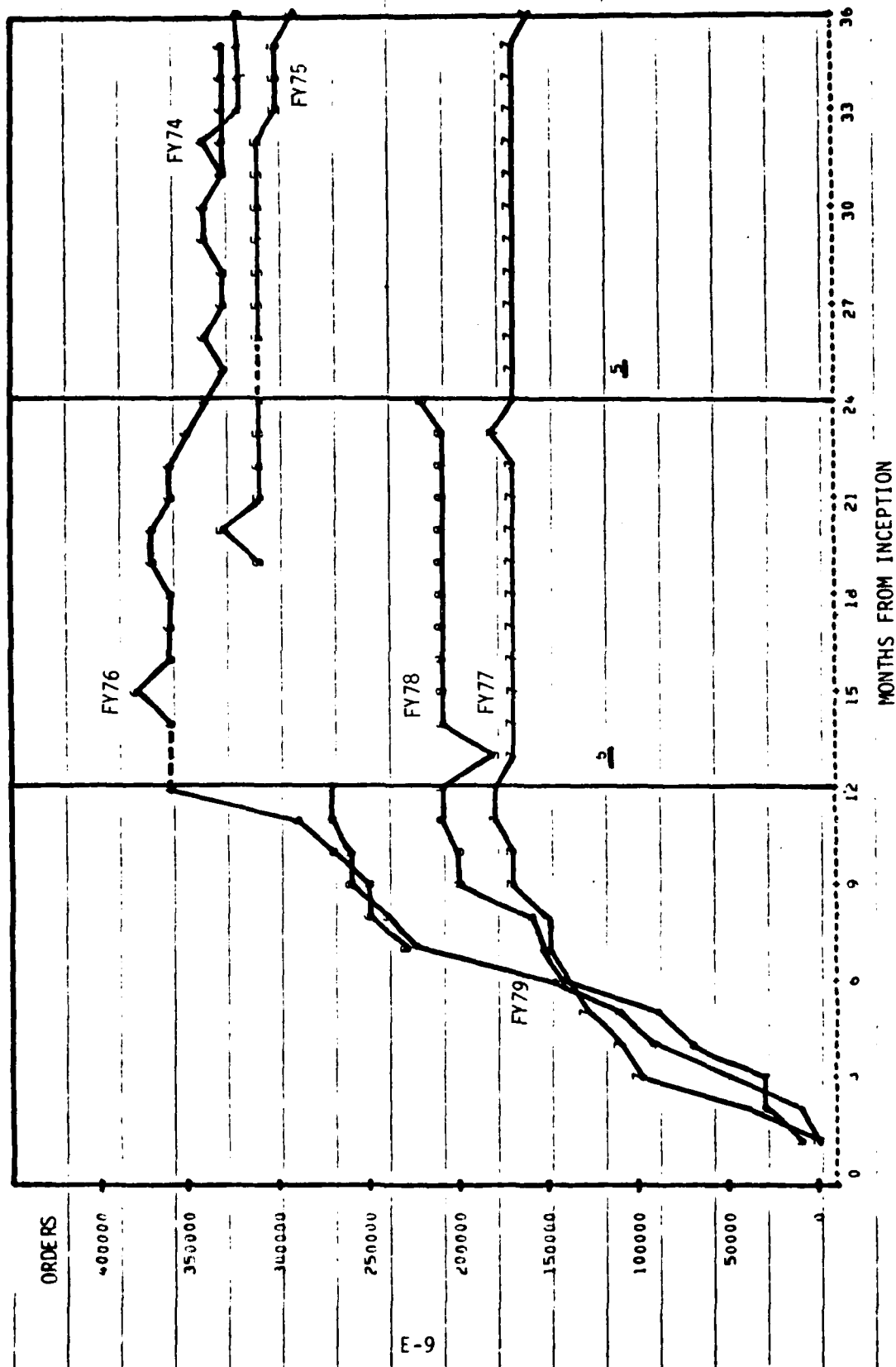| MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	0	0	0	0	0	0.000	0.000
3	.	.	.	89	0	557	215	299	0.014	0.018
4	.	.	.	90	0	557	216	299	0.014	0.018
5	.	.	.	106	1181	931	346	510	0.023	0.032
6	.	.	2496	443	1844	1037	887	391	0.059	0.020
7	.	.	2574	731	2591	1087	1540	789	0.103	0.067
8	.	.	3462	847	3767	1143	1789	925	0.119	0.055
9	.	.	3750	3663	4480	1140	3008	1252	0.212	0.100
10	.	.	3783	4147	4942	1288	3419	1451	0.240	0.114
11	.	.	3842	4302	5743	4104	4283	489	0.296	0.053
12	.	.	7856	4647	5521	2809	4283	1258	0.298	0.101
13	.	.	4157	4694	6720	.	6024	1640	0.420	0.084
14	.	.	5591	4768	6873	.	5215	1339	0.367	0.084
15	.	.	5123	4912	6923	.	5792	996	0.405	0.037
16	.	.	5147	5480	7002	.	5842	953	0.412	0.068
17	.	.	5330	5503	6696	.	5884	984	0.415	0.069
18	.	.	6522	5805	7018	.	5944	693	0.421	0.070
19	.	7347	6956	5814	7213	.	7175	1530	0.454	0.032
20	.	10150	7342	5887	7777	.	7477	1863	0.463	0.031
21	.	9805	7758	6082	7634	.	7752	1546	0.496	0.016
22	.	9963	7983	6214	8512	.	7837	1553	0.501	0.026
23	.	9940	7448	7267	8946	.	8426	1131	0.558	0.047
24	.	10591	7652	7457	.	.	8612	1499	0.561	0.071
25	.	10040	7062	7504	.	.	8399	1260	0.573	0.084
26	.	10240	7442	8059	.	.	8795	1409	0.598	0.115
27	.	10421	7167	8104	.	.	8672	1545	0.586	0.136
28	.	10519	7367	8090	.	.	8839	1455	0.599	0.116
29	.	10501	8208	8501	.	.	8984	1360	0.617	0.140
30	.	10644	8031	8223	.	.	8963	1459	0.608	0.119
31	17025	10750	8039	8259	.	.	11016	4191	0.610	0.121
32	17242	10876	8134	8291	.	.	11112	4283	0.612	0.122
33	16989	11183	8167	8310	.	.	11155	4132	0.616	0.119
34	16985	11156	8172	8343	.	.	11150	4128	0.616	0.119
35	17462	11274	8172	9778	.	.	11672	4063	0.679	0.205
36	17075	10193	9284	10759	.	.	11828	3551	0.756	0.212

PROCUREMENT OF OTHER
OTHER OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

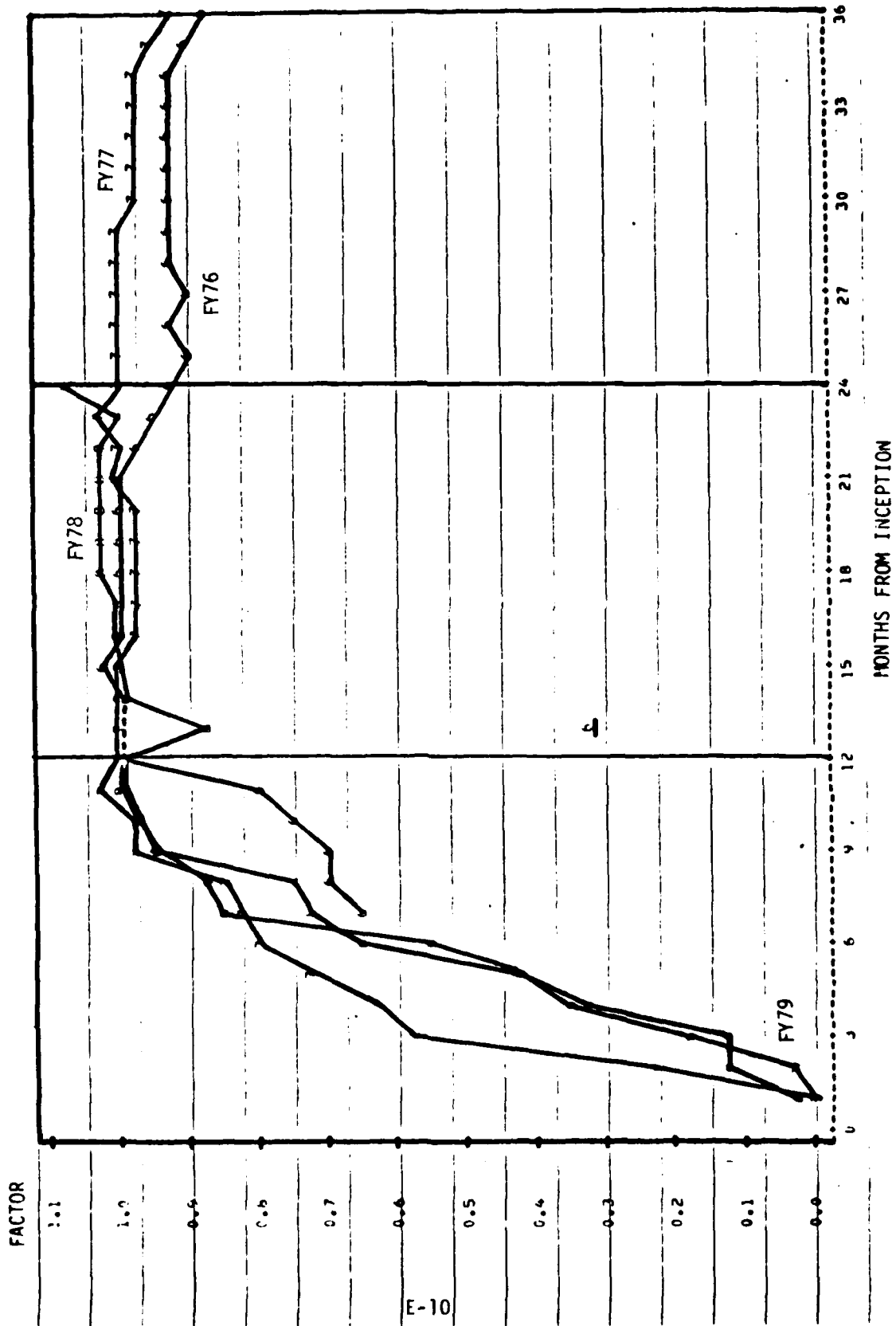| MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	0	0	6	2	3	0.000	0.000
3	.	.	.	18186	439	1530	6716	9946	0.094	0.149
4	.	.	.	18391	860	1749	7000	9875	0.097	0.150
5	.	.	.	20209	2143	2540	8297	10318	0.111	0.160
6	.	.	.	29418	15911	10455	18595	9762	0.214	0.189
7	.	.	33439	33722	18721	13506	24848	10307	0.285	0.186
8	.	.	46300	33077	21223	16058	29165	13463	0.330	0.211
9	.	.	59009	48630	30390	37755	43946	12529	0.485	0.248
10	.	.	60639	51248	33545	52042	49369	11374	0.534	0.231
11	.	.	60683	54683	34327	58011	55426	12635	0.588	0.216
12	.	.	58576	60533	72667	106824	77150	20415	0.778	0.137
13	.	.	16255	60586	73218	.	50020	29915	0.554	0.351
14	.	.	71502	61148	74359	.	69003	6951	0.773	0.158
15	.	.	73375	61446	77965	.	70929	8527	0.792	0.148
16	.	.	76457	61331	78378	.	72055	9337	0.804	0.154
17	.	.	76940	62303	81340	.	73534	9970	0.819	0.146
18	.	.	77645	62961	82663	.	74423	10239	0.828	0.145
19	.	57327	79217	63864	86549	.	72264	12822	0.849	0.136
20	.	91740	79527	64112	88154	.	80884	12300	0.856	0.131
21	.	191670	81757	64785	90197	.	107042	57115	0.874	0.132
22	.	72929	82649	65154	89959	.	107447	57339	0.878	0.117
23	.	93619	93532	65403	90446	.	75749	13302	0.884	0.139
24	.	94698	90843	66737	115519	.	83707	24058	0.473	0.038
25	.	131402	84758	67029	.	.	55730	36032	0.983	0.000
26	.	95737	91412	66965	.	.	74705	14482	1.021	0.056
27	.	96148	95250	69239	.	.	73546	10253	1.002	0.018
28	.	96511	97947	66962	.	.	73807	12248	1.001	0.027
29	.	96646	88224	66731	.	.	73867	12434	1.001	0.032
30	.	97799	98507	66829	.	.	74378	12245	1.003	0.033
31	41030	97936	99753	66858	.	.	66394	19930	1.010	0.043
32	41215	99428	98336	66938	.	.	67718	21290	1.031	0.071
33	41095	99290	98663	66747	.	.	66449	19532	1.003	0.035
34	41146	99226	88904	66840	.	.	66530	19600	1.005	0.038
35	40772	98482	89022	67081	.	.	66339	19777	1.008	0.035
36	38064	98676	94216	70823	.	.	65444	23470	1.065	0.039

PROCUREMENT OF OTHER
TOTAL (FMS+MAP+OTHER) OBLIGATIONS, IN THOUSANDS
CUMULATIVE FROM INCEPTION.

MONTH	FY1974	FY1975	FY1976	FY1977	FY1978	FY1979	MEAN	S.DEV.	FACTOR	S.DEV.
1	.	.	.	0	0	0	0	0	0.000	0.000
2	.	.	.	0	2808	6	938	1619	0.005	0.008
3	.	.	.	29049	1768	2091	10969	15658	0.061	0.091
4	.	.	.	43611	4337	3008	16985	23068	0.094	0.135
5	.	.	.	45844	6933	6468	19748	22601	0.106	0.135
6	.	.	.	57152	34391	16979	36174	20146	0.185	0.132
7	.	.	126759	62539	38301	55483	70771	38689	0.274	0.091
8	.	.	146758	64708	45753	61593	79706	45472	0.306	0.094
9	.	.	163834	96214	61210	105052	105578	42608	0.422	0.107
10	.	.	172343	102217	69752	120742	114264	42917	0.461	0.102
11	.	.	175161	105135	74942	154439	127920	44918	0.508	0.106
12	.	.	228999	126859	120261	200914	169258	54066	0.671	0.082
13	.	.	59864	127177	120437	.	102499	37060	0.490	0.291
14	.	.	242100	129567	123346	.	165018	66827	0.666	0.073
15	.	.	243577	129543	129086	.	167402	65970	0.676	0.060
16	.	.	244124	130608	131186	.	169973	67682	0.686	0.058
17	.	.	246930	131875	134285	.	171030	65742	0.692	0.055
18	.	.	250505	134854	135360	.	173573	66626	0.703	0.061
19	.	237396	255059	138082	140464	.	192750	62177	0.721	0.060
20	.	323051	255897	139062	142412	.	215106	90154	0.727	0.059
21	.	373053	262073	140346	145998	.	230368	110433	0.741	0.053
22	.	374049	262514	140928	145537	.	230767	110882	0.762	0.056
23	.	242561	270719	142432	147299	.	200753	65579	0.755	0.054
24	.	245728	276187	143945	175148	.	210270	61210	0.807	0.044
25	.	70916	275725	144138	.	.	163616	103819	0.790	0.067
26	.	247525	278501	144623	.	.	224216	70436	0.795	0.043
27	.	250101	278001	146689	.	.	224930	69180	0.800	0.053
28	.	250536	278924	144056	.	.	224504	71102	0.794	0.040
29	.	250728	279452	143068	.	.	224416	71898	0.792	0.035
30	.	251952	279744	143250	.	.	225049	72209	0.793	0.035
31	265258	252297	280481	143797	.	.	235628	62246	0.796	0.036
32	269696	254534	286965	151400	.	.	240649	60956	0.826	0.054
33	267250	254203	281630	151282	.	.	238591	59274	0.819	0.064
34	267393	254763	282026	151316	.	.	238875	59426	0.819	0.064
35	267588	254649	282340	145417	.	.	237399	62385	0.803	0.039
36	264518	253737	284503	150774	.	.	238383	59781	0.821	0.057

PROCUREMENT OF OTHER, ORDERS IN THOUSANDS, CUMULATIVE

E-9

PROCUREMENT OF OTHER, ORDER FACTORS

FACTOR

E-10

MONTHS FROM INCEPTION

PROCUREMENT OF OTHER, OBLIGATIONS IN THOUSANDS, CUMULATIVE

OBLIGATIONS

400000
350000
300000
250000
200000
150000
100000
50000

E-11

MONTHS FROM INCEPTION
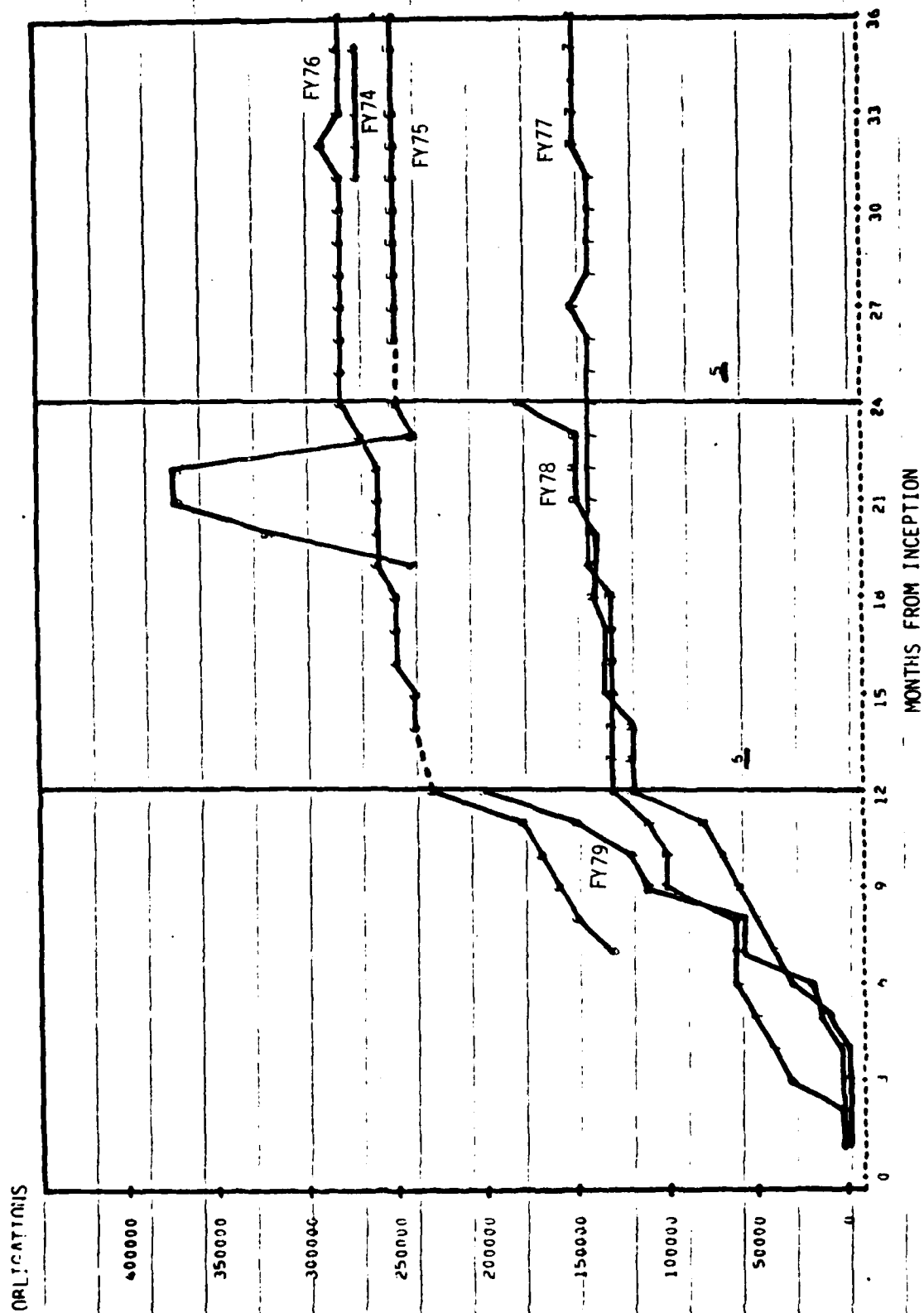
PROCUREMENT OF OTHER, OBLIGATION FACTORS

FACTOR

MONTHS FROM INCEPTION

E-12
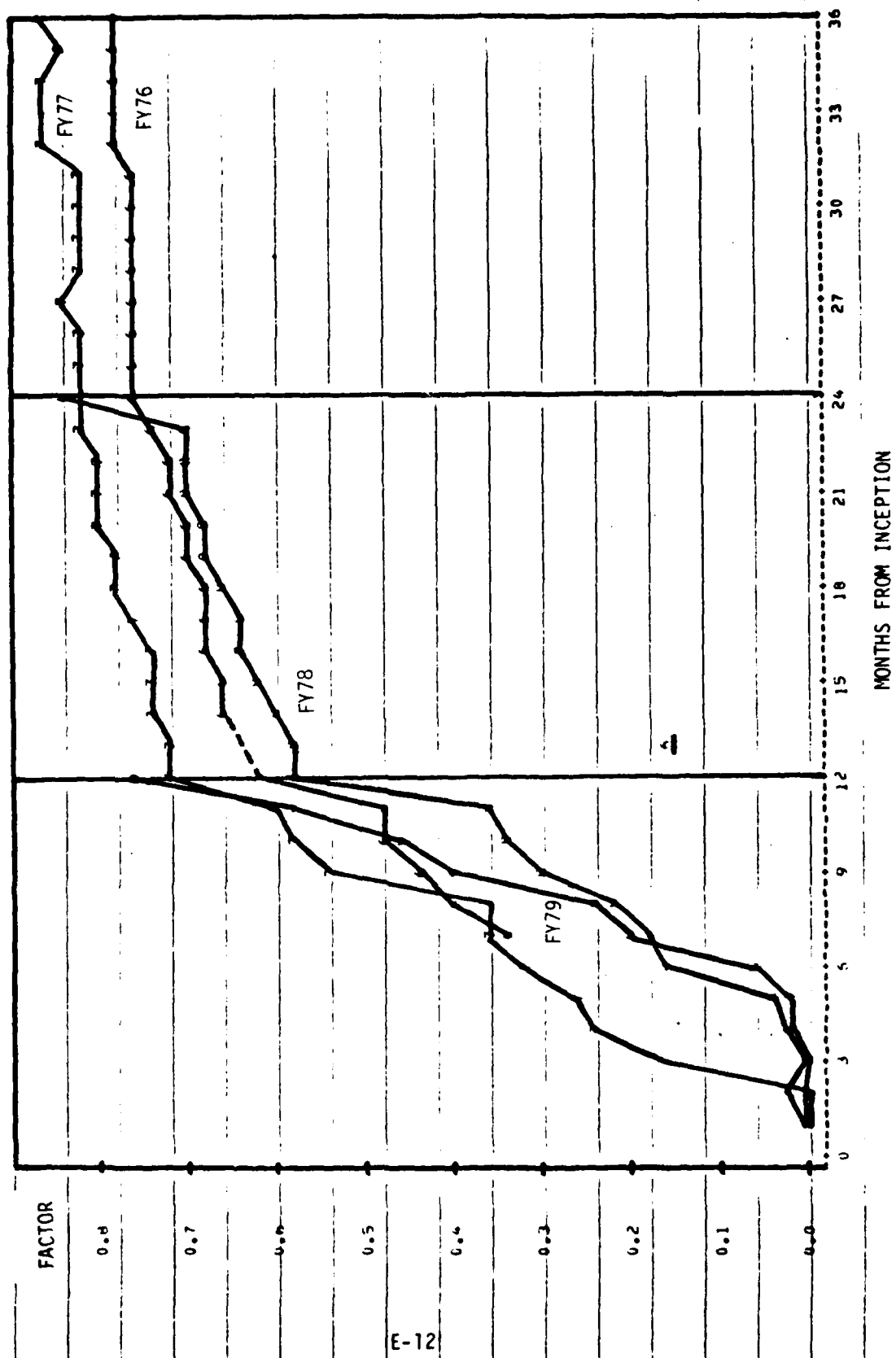
Security Classification

DOCUMENT CONTROL DATA - R & D		AD-A085110

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
US Army Procurement Research Office US Army Logistics Management Center Ft Lee, VA 23801	UNCLASSIFIED
	2b GROUP Distribution Unlimited

3 REPORT TITLE

Forecasting Army Budget Commitments and Obligations   APRO 902

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

FINAL

5 AUTHOR(S) (First name, middle initial, last name)

Richard C. Brannon, Uldis R. Poskus

6 REPORT DATE	7a TOTAL NO OF PAGES	7b. NO. OF REFS
January 1980	116	13
8a. CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S)	
b. PROJECT NO	APRO 902	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.		

10 DISTRIBUTION STATEMENT

Distribution of this document is unlimited

11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
	US Army Materiel Development & Readiness Command, 5001 Eisenhower Avenue Alexandria, VA

13 ABSTRACT

This study seeks to forecast the amount and timing of procurement obligations for the Army's customer program. The authors review budget execution policies and procedures and various approaches to economic forecasting, including regression based methods and Box-Jenkins forecasting (both univariate and transfer functions). Data are collected and analyzed. A Box-Jenkins analysis shows that the timing of orders does not drive the timing of obligations and that orders cannot be used to give time phased statistical forecasts. However, the amount of year end orders does influence the amount of year end obligations and the patterns are similar from year to year. These facts allow forecasts to be made. Organizational considerations seem to be influencing the process. Other findings, conclusions and recommendations are provided in the study.

DD FORM 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Statistical						
Forecasting						
Financial						
Management						
Procurement						
Army Budget						
Planning						